THE HISTORY AND CHRONOLOGY OF GUNPOWDER AND GUNPOWDER WEAPONS

(C.1000 TO 1850)

HENRY PRATAP PHILLIPS

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Obtaining appropriate photographs for this volume were difficult. As many photographs of surviving examples of gunpowder weapons as possible have been included to illustrate the descriptions in the texts. This task was made possible due to the cooperation of the custodians who supplied the photographs, permitted photographs to be taken, or allowed photographs to be reproduced.

In conclusion, the author would like to express gratitude to all the people whose scholarly works have helped understand this fascinating subject. The author could not avoid reproducing or coping some of their styles and modes of expression in this work.

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Preface

This book is the outcome of twelve years of study and intensive research by Lt. Col. H.P. Phillips, my father. It is very sad that after all this hard work he passed away even before the book could be published. I have worked to successfully complete this book as a tribute to his efforts. He was in the army and very knowledgeable about guns and gunpowder. He also was an avid shooter and enjoyed this sport. It was his desire to author a book about guns. Initially, he had thought about writing a book on shotguns. However, in the process of "backward integration," he decided to write about gunpowder. He found this subject fascinating, and the more he delved into the subject, the more he wanted to learn. I remember that on many occasions he spoke a lot about locks, pans, stocks, etc., which was "Greek and Latin" to me. I have decided to get his work published, and I can visualize his excitement and fascination for the subject. Luckily, I was also exposed to guns and gunpowder at a very early age and I feel honored to follow my father's footsteps.

It has been a good experience to complete his book. Many people from different walks of life have helped to publish this book as a tribute to my father, who was their friend, philosopher and guide. My father was well respected and his name alone opened doors, which were otherwise closed. I thank all for their contributions, however, small toward this project. I would like to thank my friends: Mr. C. Sridhar Rao, his gracious parents Gen. C. Sudara Rao and Mrs. Rajam who were very helpful throughout the work; Mr. Mahendra Prasad, a keen sportsman and a very dear friend of the family who encouraged me throughout the work; Mr. Raju and Mrs. Sheetal Bhatt for providing the numismatic background wherever needed; Mr. Pinaki Deb and Mr. Prashant Sharma for inputs in graphic designing and invaluable

help with the image content. I would also like to express my gratitude to Late Mr. Madhu Sharma, my uncle, who started the project by retrieving the manuscript that was believed to have been lost and I cannot really repay him for this act. I will always be indebted to him. I am very grateful to Ms Nancy Raj, who undertook the typing and secretarial aspects of the project and executed the work flawlessly. Without her, I would still be left with an incomplete manuscript. Finally, I would like to thank my mother, Late Mrs. Kamal Pratap, who encouraged and constantly pushed me to complete the work. It is indeed unfortunate that she has passed away before the manuscript could be published. I thank my wife Indu for her patience so that I was able to work in peace. She painstakingly read, reread and edited the manuscript. Thanks are also due to Mrs. Sheebani, my sister and Col. V.K. Rajendran, my brother in law. I thank my youngest sister Mrs. Shipra and her husband Col. P.K. Nair who provided constant support. I also thank my son Mr. Vikram Pratap and Mrs. Amita, his gracious wife and my dearest granddaughter Maheya (Tinky) who were an eternal source of motivation and inspiration.

Finally, I would like to sincerely and humbly thank and express my gratitude to all who have contributed toward the completion of this project.

Pradeep Kumar Phillips

Foreword

I first met (then) Major Henry Pratap Phillips in 1959 when he was posted to 512 Army Base Workshop EME, Kirkee, near Poona, of which I was the Commandant (with a rank of Colonel). He was an extremely personable officer with a keen sense of humour. Our association continued when he was later posted to Delhi Cantonment with a rank of Lieutenant Colonel.

During the many years that I knew him, I was aware of his fondness for weapons and hunting but not of his scholarly prowess for research work. Hi compilation of 'The History and Chronology of Gunpowder and Gunpowder Weapons' is a masterly treatise.

This book deserves a place in all libraries, especially of the Armed Forces and those dealing with Defence and Military affairs.

Full credit is due to Pradeep Kumar Philips, son of (late) Lt. Col. H.P. Phillips, for resurrecting the manuscripts and bringing out this book.

Chennai

3 November 2015 Lt. Gen. C. Sundara Rao, PVSM, ADC (Retd.)

Chapter 1
Introduction

Prehistoric humans discovered and used weapons to kill wild animals for meat, hides and tallow and to defend themselves from their adversaries. Prehistoric humans constantly endeavored to devise more weapons to kill accurately from a distance as the wild game became more wary and the enemy elusive. Probably, the first improvisation was to cast the stone with a sling rather than by hand. Soon, by attaching the sling across the springy twig, they could launch the stone farther. Later, they invented the stonebow and substituted the stone with a thin long shaft of bamboo, reed or cane tipped with a piece of sharp or pointed stone, bone or. This not only increased the range and improved the accuracy of the missile – the arrow – but also enhanced its lethality. This simple weapon – the bow – was the most popular projectile weapon used for both war and sport and remained in use for nearly fifty centuries. One invention that followed the above inventions not only because of the impact on both defensive and offensive warfare but also because it marked a new beginning was gunpowder.

Soon after the discovery of gunpowder, the feasibility of utilizing it as a propellant in weapons was considered. The bowman tried to shoot his arrows by exploding a small amount of gunpowder and the artilleryman experimented to launch heavy missiles with a greater amount of powder. Initially, these weapons were inaccurate, ineffective and virtually useless in damp or inclement weather. The powder had to be protected from the wind and weather, the method of ignition was crude and clumsy and the weapons often exploded and blew up killing the men firing it. Despite this problem, a new type of arms gradually gained popularity and was soon universally

adopted for both war and sport. A gunpowder weapon, which is a culmination of humans' endeavor to kill adversaries from a distance and to destroy both offensive and defensive armament, includes many lethal arms such as cannon, handguns, muskets, guns, rifles, pistols, revolvers and so on.

Although, after the introduction of gunpowder weapons changes in strategy of defensive as well as offensive warfare were seen, the early history of development and use is obscure. Scholars who examine the early literary source, particularly those of oriental origin, for references to gunpowder and gunpowder weapons encounter many difficulties. The major difficulties are to locate relevant treatises and manuscripts dated with reasonable certainty, to establish the authenticity of the transcripts and translations of nonexisting originals, to detect subsequent interpolations, to ascertain when certain words or terms could mean gunpowder or gunpowder weapons, actually meant when they were originally recorded and to differentiate the weapons that hurled incendiary or material (fire weapons) from those that were used as explosives (prototype gunpowder weapons).

Unfortunately, original Indian literary works mentioning gunpowder dated before the eleventh century and gunpowder weapons dated earlier than the fourteenth century are extremely rare. Some later transcriptions or translations of nonexisting originals believed to be of these periods cannot be entirely relied upon as most of them could neither be dated nor were authentic. They are mostly rendered at a much later period and are generally misconstrued by anachronistic interpolations. Also, wrong technical terms are used in translating treatises and manuscripts. For example, the much quoted Sanskrit treatise *Sukraniti*, "Element of Polity of *Shukracharya*," a work believed to be contemporaneous with *Manusmriti*, was assigned by some scholars to the sixth century B.C. In a later translation of *Sukraniti*, the original not being in existence, a description of iron gun, cannon and other explosive powders, believed to be gunpowder, is given. Some of the procedures described to make these weapons are nearly the same as those given in the Chinese military treatise, *Wu Ching Sung Yao*, believed to be

compiled in c. 1040 A.D., of which only a fifteenth-century copy is now available. The verses mentioning and describing gunpowder and gun are given in about a dozen stanzas in Chapter 4 of *Sukraniti*, and so there is a probability that these verses could be later interpolations. This surmise is also supported by the fact that Kalidasa, a great poet and dramatist who lived in India before 450 A.D. and the chief of the traditional nine gems (*Navaratna*) of the court of Vikramaditya, does not mention either gunpowder or guns. Similarly, in another important work "Polity *of Kamandaki*" of unclear authenticity and of the period well after the second century B.C., there occurs no reference to either gunpowder or guns. The *Vayu Purana* and the *Matsya Purana* composed in the Gupta period, fourth and fifth centuries, do not mention firearms. Also, there are none in the *Agni-Purana* (c. ninth century A.D.) in which four chapters are devoted to the subject of training in the use of arms and armor, archery being the main topic. Hence, the generally accepted concept is that in the present form *Sukraniti* is probably of the period after the fifteenth century.

Many words and terms occurring in some ancient works in both oriental and occidental languages are now translated to mean gunpowder and gunpowder weapons, but it is not certain what they meant when were originally recorded. The Sanskrit terms a*gneya-aushadha* (fire medicine), *agnichurna* (fire powder), *vanhichurna* (plant-based powder) and *gulikangra-churna* (pellet charcoal powder) are believed to mean gunpowder by Indian protagonists. The powders *hua yao* and *fa* mentioned in the Chinese treatise *Wu Ching Teng Yao* are believed to mean gunpowder by the Chinese protagonists. The *Mamluk* word *naft,* by the turn of the sixteenth century, meant gunpowder but was originally applied to other incendiary material such as *naphtha*.

Similarly, in the case of gunpowder weapons, the nomenclature is ambiguous in the present context. The Sanskrit word terms *nal* (tube), *nalastra* (tube weapon), *nalikastra* (also tube weapon), *ksudranalika* (large tubes – cannon) and *brhannalika* (large tubes – portable firearms) are

believed by some to mean gunpowder weapons. Unfortunately, a description of their constructional of functional aspects is not found, and it is, therefore, not possible to ascertain whether they hurled incendiary and explosive materials mechanically or discharged projectiles by exploding a certain amount of explosive material.

Tubes were used, long before the advent of gunpowder, to direct inflammable mixtures, more or less as modern flame throwers do. A typical example is the use of Greek fire, where bronze tubes by were used by the Byzantine Navy, as early as the sixth century A.D. The original Greek fire was based on *naphtha*, a highly inflammable light petroleum, and did not contain saltpeter, which forms the main ingredient of gunpowder. It would be, therefore, incorrect to term the mixture "gunpowder" or the tube through which the Greek fire was sprayed a "gun." Although by about the sixteenth-century Greek fire also contained saltpeter, it is does not mean "gunpowder."

The Latin or Greek word *ballista* (Fig. 1.1(a) & Fig. 1.1(b)) before the fifteenth century was applied to all types of missiles, throwing projectors of the mechanical type such as *arablest* (Fig. 1.2(a) to Fig. 1.2(c)) (large crossbow), *trebuchet* (large sling) and *mangonel* (stone and bolt launcher).

Early cannons were built using iron bars encased with hoops, but soon they were cast with copper, brass and bronze. When they became obsolescent they were melted down and the metal was recast into improved types of cannon. Neither the artisans fashioning them nor their patrons for whom they were cast – the Orientals – considered the crude and simple tube worthy of preservation for the benefit of posterity. Until recent times, the manufacture and use of gunpowder weapons in India was the prerogative of the ruling classes. Just before or immediately after the independence, many custodians of the erstwhile princely states disposed off, often surreptitiously, many valuable antique firearms to foreign collections. It is indeed fortunate that we still hold some good example of intrinsic value.

The other main source of information about the usage of gunpowder weapons in early warfare is their introduction on the military strategy of offensive and defensive operations. Siege craft was developed to attack well-defended localities, such as fortress and castle, by about tenth century B.C. in China and about fifth century B.C. in Europe. They were mostly scaling ladders, siege towers and battering rams assembled and used by the soldiers as the fortresses and castles were built with stronger and higher walls, and so they became long, heavy and hazardous. Tunneling through walls was carried out but it was a slow and tedious process, and the defenders built deep and wide moats to make the task of tunneling more difficult. The moats also made it increasingly difficult to use siege craft and made it less effective. The best way to enter a fortress is to either breach or destroy the massive walls using mechanically operated siege engine capable of creating big holes in the walls by breaking them down or shooting objects over them. The projectiles were large rocks, iron quarrels incendiary objects and explosive materials. These siege engines were mostly catapult or crossbow types and were known variously as Roman *ballista, onager, bambard* (fig. 4.1(a) to Fig. 4.1(e)), *mangonel* (Fig. 4.2(a) & Fig. 4.2(b)), *trebuchet* (Fig. 4.3(a) to Fig. 4.3(c)), *espringal* (Fig. 4.4), *karak, manjaniq* (Fig. 4.5(a) to Fig. 4.5(c)), *midfa, naft* and so on.

As the "artillery" of the medieval period became more powerful, the fortifications became massive with stronger walls capable of resisting enemy assaults for months or even years. Constructing larger and more powerful siege engines became impossible as they had to be fabricated/constructed in situ and with locally available materials. A large number of workers were to assemble and then dismantle them after use and so the siege engines could only be used intermittently. In some countries these siege engines were used till the fourteenth century, whereas in others they were used till the seventh century.

Soon after the introduction of gunpowder, humans thought of ways and means of using its explosive properties to operate their siege engines. The

cumbersome and unwieldy mechanical projectors then replaced simple metal tubes through which solid missiles like stone and metal balls were discharged with an exploding charge of gunpowder and with great force. Although these new gunpowder weapons, known initially as *bambards* and later as cannons, were initially inaccurate and virtually useless in inclement weather and exploded and blew up the men who fired them, of the walls of the forts and castles could not withstand the shelling by the crudest of cannon. Unlike their earlier counterparts, they were made in the rear echelons, moved to the required site and later withdrawn when not needed. The medieval castles, forts and fortresses, which, before the invention of cannon, had been regarded as impregnable, but they lost their reputations as safe strongholds, became vulnerable by the beginning of the fifteenth century and they gradually fell into disuse and were ultimately rendered useless and discarded.

Lacking mobility, early cannons were mainly used for siege operations and defense of fortifications. They were usually made in situ and moved from place to place, invariably short distances, by using oxen, elephants or horse-drawn carriages. They were placed on hastily constructed platforms or mounds of earth and aimed by raising or lowering the breech end of the barrel with supports. After each shot, the recoil dislodged the cannon and had to be relaid for the next shot. It was, therefore, hardly possible to fire a dozen shots or so in a day.

Although the cannons were deadly, they were of little use in field operations. They could be moved from place to place by the use of horses, elephants or oxens. It takes a long time to load, prime, lay and range the cannon and when these operations were done in field conditions the weapon seldom managed to hit the target. Cannons were captured and recaptured with every change in of the course of the battle, and infantry and artillery guards were especially provided not only to protect the gunners and cannoneers from the enemy but also to prevent them from running away when the enemy attacked their positions. Because the cannons were badly

made, bursting chambers or barrels were quite common and the cannoneers were also frequently killed while firing them. One wonders who was the most afraid of the cannons – the enemy troops or the cannoneers who were firing them. The sudden and dramatic appearance of the filed artillery by the end of the sixteenth century was possible only after the invention of the trunnion, which made it possible for the cannons to be mounted on specially made carriages for better aim and accuracy.

In the descriptions of the battles of Babur, in the second quarter of the sixteenth century, there was no real distinction between cannon and field artillery pieces. The weapons that were light enough to be trundled by foot-soldiers into the battlefield – *firangi* and *zarb-zan* (equivalents of the European culverins) – were long small-calibered ordinance, and the heavy ones that required animal-drawn carriages were known as *top*. All one could say about this artillery was that they were guns, the cavalry and the infantry were still the arbiters of the battlefield.

Babur adopted a technique, not his own, as it was successfully used by the ancient nomads about a century earlier in Europe – the so-called wagon fort. At the battle of Adrianople (378 B.C.), the Goths under Fridigenn launched their cavalry attack on the Roman flank and then its rear launched their infantry from their Wagon fort to complete the work. The Goths, with their nomads, often framed their weapons into defensive features or *laagers*. The Huns also fell back upon their defensive *laagers* when necessary. In the first half of the fifteenth century, the Hussite rebels in Bohemia, under the gifted Jan Zizka, defeated one medieval army after another by means of cannon and handguns based on mobile forts of linked wagons – the ancient *laager*. In the battle of Panipat (1526 A.D.), all available baggage carts were tied up together to form a circular sector and cannons were placed at intervals in the chain so formed. Infantrymen stood behind the guns to repulse attack by the enemy and kept the gun crew with their guns, and a contingent of cavalrymen stood in readiness to charge through gaps also provided between the carts.

Cavalry reigned supreme until the advent of the gunpowder weapons. By the end of the fifteenth century, the medieval knight was clad in the strongest and heaviest suit of plate armor and was also protected by the armor. With much difficulty, the knight maintained supremacy single handedly against a multitude. The combined weight rendered the mount slow and ponderous and could charge only at a slow canter. If unhorsed, the knight could hardly rise without assistance, but cutting and thrusting weapons could not penetrate the armor. After the musket was adopted by the infantry and the introduction of gunpowder weapons on the battlefield, however, this changed the situation. A bullet from a musket could penetrate all the thickest and best-made armor and the plate armor was of little use against missiles dispatched from projectile weapons by means of gunpowder. With the invention and use of gunpowder weapons, the armies were quite invincible even stronger foes. The valiant chivalrous, horse-mounted and armor-clad knight withdrew from the battlefield. Cavalrymen had to give way to humble infantrymen who were armed with crude muskets. After the introduction of the pistol and carbine, the equestrian combatant was armed with a pair of pistols at the saddle, a saddlebow, and perhaps, another pistol tucked into his right boot. The ascendance of infantrymen resulted in the loss of cavalrymens' preeminence.

Who invented gunpowder and gunpowder weapons? When? Where? These are issues that have been subjected to investigation and discussion, but generally acceptable explanations are yet to be found. A legend, an illustration, a term, or an excavated piece may sometimes provide clues, but all were fragmentary and inconclusive as a puzzle where half the pieces were lost.

Little research has been done on whether or not the Indians knew about gunpowder or gunpowder weapons before others. The little work that has been done is mostly by scholars who are not sufficiently conversant with the basic technical and functional aspects of arms in general and firearms in particular. The average Indian student of arms and armor has probably less

knowledge about firearms. The student had the general idea that artillery consisted of big guns and infantry and cavalry were equipped with smaller guns. The few scholars who tried to study the history and chronology of usage of gunpowder and gunpowder weapons in India unfortunately greatly relied on copies or the translations of ancient treatises, believed to be transcriptions of nonexisting originals or containing information presumed to be based on earlier sources, which could neither be dated nor authenticated.

To examine these controversial issues in the correct perspective, proper understanding of the fundamental historical background about formative stages of developments of firearms in their countries is indispensable. The author, therefore, devoted a large section of this book to elucidate the important contributions of some major arms-producing countries of the world.

Indeed, Indian literary sources on gunpowder and gunpowder weapons in their formative years, which are reliable and authentic, are extremely rare. Although there are a few monographs that dealt with the subject, the student needs to be thorough with the fundamentals of the subject to guard against the many errors in them. The few located by earlier scholars are not always readily available to students. There are many other relevant sources of information, such as surviving examples of gunpowder weapons or their depictions in sculptures, frescoes, murals, illustrations and so on, of the contemporaneous period. However, scholars examining them have to seek far and wide, often with disappointing results, due to lack of proper guidelines to follow. It is indeed unfortunate that there are no books extant, which serve as a guide to the student. The Hindus of early historic period have left us no authentic records and historic literature, and trustworthy documents do not exist. The Hindus, just as the orientals of the period, had no interest in historical researches. The Brahmins were the only literate caste who could read and write and most of the surviving literary works are ascribed to them. They used their talents to write about religion of which

they were the sole interpreters and guides. They praised their patrons and monarchs. Why should a Brahmin engage himself in writing about a subject that does not provide any material or spiritual benefit?

Public education lagged far behind. The Brahmins saw no reason to encourage public education and reduce their own importance. They instinctively knew that the illiterate and stupid population safeguarded their own influence and indispensability. The best of the weapons were useless unless accompanied with appropriate Sanskrit mantras, which were jealously guarded secrets of the Brahmin pundits. The four Vedas, two epics and *puranas* contain useless references to contemporary historical and social background but on no account were they authentic, historically accurate and trustworthy.

As in the case of Chinese, Greek and Roman work in the contemporary period there are descriptions of legendary myths involving gods, goddesses, demons and humans. Occasionally, a passage or a verse may contain a trace of historical facts and to correctly appreciate its truth the myth with which it is shrouded has to be first weeded out.

One of the characteristics of an ancient Hindu was to connect day-to-day occurrences with some mystical (or metaphysical) cause, and it is therefore not very surprising that the Brahmin scholars are no exception to it. Brahmins were better educated and they were able to convince their readers or listeners with the myth, legends, wonders and miracles. These ancient characters with supernatural powers are mainly responsible for the popularity of all such works. Besides these, few treatises on polity, civil and military administration, weapons and low were written or complied. Occasionally, they throw light on historical or social subject. The sources of information on ancient history are written in Sanskrit language and almost all ancient works on the subject are in this language. Placing reliance on edited or transliterated versions of these Sanskrit works is usually unproductive as incorrect interpretations, wrong words used while translating, verbatim translations of words and terms, subsequent

interpolation and so on, are usually indiscernible in such works. Translated or edited versions of ancient works, which are true and correct, are indeed rare. The scholar and student historian is usually frustrated due to the lack of information available.

The primary aim of compiling this volume is to present the material chronologically, which is relevant to other allied topics to guide the future arms historians of India. It would be pretentious assume that this volume would adequately cover this vast and highly controversial subject. Nevertheless, this volume is a guide to future scholars and arms historians.

Chapter 2
Black Powder

The terms black powder and powder were gradually replaced after the introduction of terms "firearms" and "gunpowder." The components of gunpowder remained practically the same, perhaps some of the useless ingredients such as camphor, sal ammoniac, mercury and so on, added earlier were discarded.

In the early forms of gunpowder, the three components saltpeter, sulfur and charcoal, were finely powdered, sieved, kept in separate containers and mixed just before use. This was to prevent the powder becoming damp in humid weather. Much later, when the gunpowder was made by an improved process, certain other ingredients were added to it that made it possible to carry or store it in a ready mixed state.

The proportions of the three basic ingredients of gunpowder were subjected to many alterations during its long period. It could also be seen gunpowder of different countries used different compounds in different proportions.

The oxygen required to burn sulfur and charcoal contents of a charge of gunpowder was supplied by the saltpeter. The chemical reaction is given below:

$$2KNO_3 + S + 3C = K_2S + N_2 + 3CO_2.$$

The powder gases also contain traces of carbon monoxide, nitrogen and carbon dioxide. The solid residues left in the barrel and chamber and carried

away partly by the smoke during burning of the powder contain potassium carbonate (K_2CO_3), potassium sulfate (K_2SO_4) and potassium sulfide (K_2S).

Advanced techniques of manufacturing gunpowder consisted of grinding sulfur and charcoal separately into fine powder and then adding the mixture together. The saltpeter was then added and the damp mixture milled under rollers and then pressed into a cake in a hydraulic press. The cake is then broken and sieved into grains of suitable size and then dried. The size of the grains produced depended on the gauge of the sieve used, and naturally the larger the size of the grains, the slower was the rate of burning. By converting the finely powdered gunpowder into hard grains, it reduced the absorption of atmospheric moisture. The process of forming gunpowder into grains was probably done in a crude fashion in the early days and was known as "lump" gunpowder. However, in the fifteenth century the process described above was invented and the resultant granular powder was known as "corned" gunpowder. The corned gunpowder generated higher pressures when exploding in the chamber of a gun, and therefore, it could be used only when gun barrels were made strong enough to withstand the pressure.

The grains produced by the "corning" were sometimes coated with finely powdered blacklead before the grains are dried – called "glazing." This not only prevented the grains from sticking to each other and forming lumps while drying but also gave them a thin waterproof coating of blacklead.

Gunpowder used for cannons had big grains and was called "prism" gunpowder – hexagonal grains of definite sizes. In some countries, the percentage of the basic ingredients was also slightly modified. Prism gunpowder and brown gunpowder were used as propellants till they were replaced by modern smokeless powder based on guncotton and nitroglycerine.

Peterson[1] records various compositions of gunpowder till the eighteenth century. Roger Bacon, in the year 1260, mentions that the proportions used in gunpowder were as follows: 41% saltpeter, 29% each of sulfur and

charcoal; English gunpowder in the year 1350 contained 66.7% saltpeter, 11.1% each of sulfur and charcoal; German gunpowder in the same period was 66.7% saltpeter, 16.7% each of sulfur and charcoal and by about 1400 it was modified to 71% saltpeter, 13% sulfur and 26% charcoal. Prussian gunpowder in the year 1774 was 80% saltpeter, 10% each of sulfur and charcoal and by about 1800 it was about the same as the English gunpowder of 1718–75% saltpeter, 10% sulfur and 15% charcoal. Swedish gunpowder in the year 1827 was 75% saltpeter, 15% sulfur and 10% charcoal. The English gunpowder had the same composition for all kinds of arms, the difference being only in the size of the grains. Although in France, different compositions were used for powders used for cannon, muskets and pistols. Of course, the basic principles were that the barrels should withstand the pressures generated in the chamber when the powder explodes and the combustion of the powder charge should be complete by the time the projectiles left the barrel.

It is apparent that knowledge about the composition and explosive properties of gunpowder spread rapidly in many parts of the world, particularly among the military who appreciated its potential. Although it was merely another highly combustible mixture, like many others, gunpowder ultimately assumed its own identity as an example and was known by many different names in various languages. Thus, in the early accounts of pyrotechnics and fire weapons, it is rather difficult to say whether the progressively burning or exploding powders used were gunpowder in the modern sense of the word or some other inflammable or explosive powders: proto-gunpowders. This is particularly so in the languages of the Eastern World where some words that could now be translated to mean gunpowder had other meanings.

It is also unfortunately true that original books and manuscripts of the tenth and eleventh centuries, which is the crucial period in the history of development of gunpowder, are extremely rare. Some later copies of such works, believed to be of this period and available at present, are not entirely

reliable. Their translations, invariably rendered at much later periods, are generally misconstrued and quoted out of context by some early arms historians. It is also apparent that subsequent interpolations were made in copies of many such texts while they were transcribed later. Some translators, commentators and editors in examining such transcriptions could detect neither spurious matter nor excluded them from their own works. Ultimately, some spurious material merged with the original texts. It could also be seen that some early historians and chroniclers deliberately incorporated many such interpolations in their own works only because they conformed to their own beliefs. It has thus become indispensable that all documentary evidence said to be of the period earlier than the thirteenth century must be thoroughly screened before serious consideration.

The Arabs and their tribes, such as the Saracenes[2] and Moors[3], seem to have played bigger roles in the history of development of gunpowder and transmitted this knowledge to the Western World than thought of earlier. True gunpowder was used first in the Spanish wars with the Moors in the twelfth century by both sides. It is obvious that this knowledge about the composition and its propulsive powers, invented in China or India, reached Europe by the third quarter of the thirteenth century and it is believed that some Arab scholars brought this knowledge to Europe. Although the exact detail of how and when it reached Europe is obscure, Bacon's treatises indicate that the Europeans knew about it by the third quarter of the thirteenth century, at least. According to Blackmore[4], this hypothesis is supported by an Arabic manuscript of the fifteenth century, formerly in the Musee Asiatic in St. Petersburg. The original composition of this manuscript has been dated on no very certain grounds between 1300 and 1350 A.D.

Peterson[5] records that an Arabic manuscript of about 1225 describes incendiary compositions, but not gunpowder. A work by *Hasan al-Rammah*, probably written about the year 1280, quotes earlier authors, describes the purification of saltpeter and gives many compositions of fireworks, which are described as Chinese. It does not describe gunpowder, although it

describes the use of gunpowder as a propellant. Some of the soldiers in this work bear Mongoloid features and the incendiary and fire weapons illustrated are reminiscent of the Chinese treatises, *Wu Ching Tsung Yao* and *Wu Pei Chih*, mentioned earlier. Both gunpowder and cannons were known in Europe by this period as gunpowder was mentioned by Bacon in the year 1267, and an illustration of a gun, in the form of an illumination, is shown in an Oxford manuscript of the year 1326.

According to Oppert[6], there exists an old tradition, according to which the Arabs possessed at an early date, a knowledge of the manufacture of gunpowder, and that they obtained it originally from India, with whom they had an active trade. They have even improved on the original manufacturers. The Arabs received the earliest gunpowder supplies from India; that India invented gunpowder was very strongly advocated by M. Langles as early as the end of the eighteenth century in a paper presented in the French Institute in 1798.

2.1 Prototype of Gunpowder

Many incendiary and explosive mixtures – prototypes of gunpowder – were used as early as the eleventh century both in China and India. They were used extensively in the Chinese pyrotechnics in the same century. The simple pyrotechnics, such as fire crackers, were also used as psychological weapons, the clouds of smoke, bright flashes and loud reports, to surprise the enemy and create panic. The propulsive powers of the explosives used in such pyrotechnic weapons were not utilized and the energy generated by the exploding charge did not discharge a projectile to penetrate targets.

Both the Indian and Chinese sources dateable to a period earlier than the eleventh century mention a number of explosive powders and mixtures, which were undoubtedly prototypes of gunpowder.

In the existing transcripts or translations of some ancient Sanskrit works, such as the *Nitiprakasika, Atharvana-Rahasya, Sukraniti, Agnipurana, Mahabharata* and so on, some combustible substance and explosive mixture

while describing pyrotechnic or fire weapons. For instance, the *Sukraniti,* written by Shukracharya[7] (c. 200 B.C.) speaks of *agnichurna,* literally fire powder; and the Mahabharata, believed to be written by an ancient sage Vyasa[8] about 2,000 years ago, mentions *aagneya-aushadha*, literally fiery chemical or fiery medicine. They were undoubtedly highly combustible or explosive mixtures or chemicals – possibly prototypes of gunpowder – but unfortunately it cannot be positively established that they were gunpowder.

The Indian evidence of ancient times certainly points to the use of explosive powders or fiery chemicals – proto-gunpowder – in fireworks and fire weapons – to launch objects without the thought of penetration. Missiles carrying inflammable or explosive material were launched by mechanically operated devices for setting fire to enemy installations and equipment or to cause confusion among enemy ranks by producing loud explosions. Whether any one of these powders was true gunpowder, as we know it today, is not yet certain.

The Chinese sources are also not very specific while discussing gunpowder. For instance, the powder contained saltpeter, sulfur, charcoal, white arsenic, stone coal, four varieties of ginger, various bitter substances and human sperm. Can it be called gunpowder?

A mixture of yellow sulfur, black charcoal and white saltpeter, all in powdered forms, was known as black powder or simply powder. Some early recipes of it included a few obviously useless ingredients, for reasons best known only to the alchemists compounding them. However, the rate of combustion of the powder and consequently its explosive properties depended mainly on the quantities and qualities of the three basic ingredients, sulfur, saltpeter and charcoal.

The black powder is a highly inflammable mixture, which exploded under certain favorable conditions. Although its earliest use was in pyrotechnics (fireworks), its explosive properties powers were soon realized and it was used as a propellant of a weak nature in pyrotechnic, fire, or weapons.

Perhaps a little later, black powder was also used in siege engines, the artillery of the period, as a propellant. The invention of gunpowder has been ascribed to different individuals belonging to different countries, but as to the question, who invented gunpowder first and exactly when and where are questions yet to be answered conclusively. The most intensive research has been done, and a number of articles have been published. Many studies and discussions have been conducted to find out generally acceptable answers, but all to no avail. The closest guess is that a black powder was first used in the eleventh century A.D. or earlier in the Far East – most probably either China or India. It is unanimously agreed that no invention within the last 600 years has been so influential in shaping the destinations of nations as the introduction of gunpowder.

All the basic ingredients of black powder are known. Sulfur, earlier known as brimstone, occurs naturally in a fairly pure form and a further purification is needed, and this could be achieved by distillation. Brimstone is known since prehistoric times as it is mentioned in the Old Testament[9]. Charcoal is a common by product of every wood fire, since man found a way to kindle it, and headlong been used as a fuel.

The third important ingredient of black powder – saltpeter – the component that differentiates black powder from other explosive mixtures appears to be rather problematic. It is saltpeter that when heated gives oxygen and promotes rapid ignition of the powder, and hence an essential constituent of any explosive mixture. According to Brent[10], the Chinese in the eleventh century discovered the value of adding saltpeter (to combustible and explosive mixtures), which released oxygen when heated.

Saltpeter is not a normal product as sulfur or common salt is formed by the slow oxidation of organic matter containing nitrogen in manure beds around stables, cowsheds, pigsties and so on. Here, the atmosphere oxygen, in the presence of basic substance, such as potassium carbonate in the form of old mortar (containing wood ashes or lime) produces crude saltpeter. The oxidation of nitrogen beds is brought about by micro-organisms (bacteria)

and supplied with nitrogen from the manure. The typical Indian method of separating saltpeter from the soil of such nitrogen beds is to dissolve it in water and boil the solution, sometimes adding potash or lime to it. As the solution cools, crystals of fairly pure saltpeter are formed. Purifying raw saltpeter involves conversion of calcium nitrate contents into potassium nitrate. In other countries, potassium nitrate is made from sodium nitrate (*Chile saltpeter*) obtained from shallow mines. It is purified by adding wood ashes containing potassium carbonate to a solution of saltpeter and water, which precipitates the dissolved calcium salts from the solution. Sulfur is found naturally throughout India. Indians used it as medicine and for washing cloths and in fireworks.

Peterson[11] records that saltpeter was probably known fairly early in India. Ray[12] states that saltpeter (most probably unrefined) was used in India from times immemorial as the basis of explosive for rocket and firearms. India was famous for the exportation of saltpeter and most European countries needed it for the manufacture of gunpowder. He was also of the opinion that the earliest account of it (probably of the refined form) on a commercial scale is in the accounts of Mandelso[13], whereas Gode[14], ex-director of the Bhandarkar Oriental Research Institute, Pune, India, quotes another historian Sarkar[15] to say that on February 6, 1627, a sum of about Rs. 2,500 was collected from the English factories at Surat as taxes on saltpeter and sugar. Although this gives us an indication that purified or refined saltpeter was manufactured in India for export by this date, at least, it is still not clear as to how long unrefined saltpeter was a commodity of Indian exports. The Dutch East Indian Company traded especially in saltpeter.

In the Old Testament[16], saltpeter or *nitre* (Greek *nitron* and Latin *nitrum*) is mentioned in two books. First, Proverbs, 25:20, which reads: "As he that taketh away a cold weather, and as vinegar upon *nitre*." Second, Germiah, 2:22 "For though thou wash thee with *nitre*, and take three much soap, yet thine iniquity is marks before me, saith the Lord God." The Latin word for nitre is *nitrom* (also called *sal nitrum* which could be translated as *salt nitre*)

is defined as a native mineral alkali, native soda or *natron*. Knox translates the first reference as: "Vinegar goes ill with *natron*, and song with a discontented heart." The second as: *"Ay, use nitre for thy cleansing, spread potash as thou may'st, foul with guilt I shall still find thee."*

Peterson[17] records: "What is called nitron by Greek authors and nitrum by Latin is not soda." This hypothesis does not appear to be entirely correct as in this first reference nitre is mentioned in connection with its adverse reaction with vinegar – an alkali with acid; and the other, in connection with cleansing operation. The former reaction is quite simple and true, and the latter is also absolutely correct as unrefined saltpeter has been used, by Indians for instance, from ancient times until today to wash clothing and bodies, and village washermen collect crude nitre from natural beds and boil the dirty linen in a solution of saltpeter and water before washing them.

Oppert said that it is now generally admitted that the nitrum (Latin), which occurs in the writings of the ancients, was not saltpeter, but natron, i.e., sodium carbonate (soda); the later word is nowhere extant in Greek or Roman literature; although the words nitrum and nitron are no doubt in their origin identical.

The word "nitre" occurs twice in the Bible. It is described as an alkali, which was used as soap. *"For though thou wash thee with nitre, and take the much sope, yet thine iniquity is marked before me, saith the Lord God."* (Jerm.ii.22); and *"as he that taketh away a garment in cold weather, and as vinegar upon nitre, so is he that singeth songs to an heavy heart"* (Proverb XXV.22).

Herodotos mentions nitrum as *litrom* in his description of the embalming of dead bodies as practiced in Egypt (*Herodotos*, II.86). Pliny repeatedly speaks of *nitrum*, and Galen records that it was burnt to strengthen its qualities (*Galinus, De Simplic.Med.Facult.IX. Compose Bechmanns's History of Inventions, II.433*). This would have no effect if applied to saltpeter. There is no doubt that had the ancients known as saltpeters, its oxidizing

properties would soon have been discovered by them, which is the most important step toward the invention of gunpowder. (The original Greek fire of the seventh to tenth century did not contain sulfur, which would have greatly enhanced its combustion properties, is discussed later).

The word *natron* was introduced in Europe from the East by some European scholars who had been traveling there, about the middle of the sixteenth century and who had became acquainted with this salt (see J. Bechmanns's *History of Discovery*, under the head saltpeter, gunpowder, aqua fortis) and though the word *natron* was originally used for denoting saltpeter, its other form *nitrom* has been assigned to it; however, as we have seen, the *nitrom* of the ancients is quite different from our *nitre*, which is saltpeter (potassium nitrate). Saltpeter produced entirely by natural processes is found in India, Egypt and some parts of America. It was obtained from the efflorescence on water (*sal muriale*) and other sources; this exudation was refined, to obtain saltpeter suitable for producing gunpowder. In the Bengals and The Punjab (district Ferozpur), it is gathered in large masses as effervescence on the soil.

Oppert said (page 60): In the *Sukraniti*, saltpeter is called *suwarchilavana*, shining salt. It is clearly mentioned in the description of the salt *dhanvaritarin-nighantu and amarakiza S(IX)43 and 110*) and described as the – *souchal salt (dhanavantarinighatu*).

The earliest Chinese sources mentioning incendiary and explosive mixtures containing saltpeter are military treatise *Wu Ching Sung Yao* believed to be compiled in c. 1040 A.D. Unfortunately, only a fifteenth century copy of it is available now in which some later interpolations appear to have been made. In this treatise, black powder gunpowder – actually a prototype of black powder – is mentioned which contained Hsiao Shih, presumed to be saltpeter.

Peterson records that in the Arabic annals the use of saltpeter for cooling water is described in some medical works of c. 1250. The Arabic work of

alchemist (Arab experimental chemists were known as alchemists) *Nadj-ud-din Hassan ab Hammh*, probably written in the year c. 1280, quotes earlier authors, describes the purification of saltpeter, and gives many compositions of fireworks, which are described as Chinese. Another author Ibn-al-Baytar, who died in the year 1248 and was well acquainted with Indian and Persian drugs, calls saltpeter *chaoj-al-sin*, literally snow of *China*.

These references indicate that saltpeter and knowledge about its usage in pyrotechnics were known to the Chinese and Arabs by the mid-thirteenth century.

[1] Peterson, H.L. Encyclopaedia of firearms. *The Connoisseur*, London, 1964.

[2] A Syrian or Arab nomad, a Muhammadan, an opponent of the Crusaders.

[3] A non-Christian, a Muslim of the time of the Crusades, a member of the mixed Berber and Arab people of Morocco and Barbary Coast; one of the Arab and Berber conquerors and occupants of Spain from 711 **A.D.** to 1492 **A.D.**

[4] Blackmore, H.L. *Guns and Rifles of the World*. London, 1965. p. 3.

[5] Peterson, H.L., op. cit., p. 149.

[6] Oppert, G. On the weapons, Army Organizations and Political Maxims of The Ancient Hindus with special reference to Gunpowder and Firearms, Madras and London 1880.

[7] Shukracharya. *Sukraniti, The Elements of Polity of Shukracharya*. Vidyasagara, versex 202. p. 555.

[8] Vyasa. *Mahabharatha*. Chitrasala edition, Pune, 1929, p. 17.

[9] *Old Testament*. King James Version, Proverbs 25:20 and Jermiah 2:22.

[10][10] Brent, P. *The Mughal.*

[11] Peterson, H.L. Encyclopaedia of firearms. *The Connoisseur*, London, 1964, p. 149.

[12] Ray, P.C. *History of Hindu Chemistry*. Vol-I. Calcutta, p.100.

[13] de Mandelso, J.A. The travels of John Albert Mandelso from Persia to East Indies. London, 1669.

[14] Gode, P.K. *Use of Guns and Gunpowder in India*. p.9, fn.9.

[15] Sarkar, J.K. Transport of saltpetre in India in the seventeenth century. *Journal of Bengal and Orissa Research Society*, XXV, Pt. I, March, 1939.

[16] *Old Testament*.

[17] Peterson, H.L., op. cit, p.147.

Chapter 3
Gunpowder

The discovery of the fire set humans apart from the rest of creation. Initially, fire was used for promoting his comforts such as proving warmth, light and heat for cooking. Later, fire was used by for more aggressive pursuits, such as destruction of properties and dwelling of adversaries. The next natural step was to devise ways of using fire as a weapon, in the form of missiles. Humans had a better chance of victory, if the missile could be launched large distances.

He discovered soon that some material caught fire easily and some substances and compounds burned fiercely when set alight and could not be extinguished easily. They were ideal for incendiary purposes in warfare.The earliest substances used were fat and tallow, and they were continued to be used as incendiaries in warfare till the mid-thirteenth century.

The other substance that was used for incendiary purposes as early as the sixth century A.D. was *naphtha* or *naft* in Persia. Arabic light petroleum was a highly inflammable and volatile liquid, which included asphalt and bitumen found in natural beds. Missiles soaked with *naphtha* and set alight were launched at the enemy to cause confusion and panic. Such blazing missiles were used to start fires inside the enemy's defense. *Naphtha* vapor, like other gases of the same class, in combination with atmospheric air exploded, which even on a moderate scale, alarmed the elephants and horses on the battlefield and caused panic and terror.

In ancient Sanskrit literature, we find reference to *agneyastra* (fire weapon), which probably included arrows, darts, or spears tipped with oiled

flax, resin, sulfur, regular, *naphtha*, or other bituminous substances discharged by hand, bows and sometimes by elaborate machines designed to hurl them far.

Kautilya, also known as Chanakya, the great Indian scholar, tactician and writer on weapons and warfare, the chief adviser to Emperor Chandragupta Maurya (c. 300 B.C.) recommended: "Arrow spitting fire and birds with their launchers and other."

The English word "artillery" was originally applied to almost all weapons. It is mentioned in the Old Testament of the Bible I Samuel, 20:40 King Kames Version (1611) and reads:

"And Jonathan gave his artillery to his lad and said to him, go, carry them to the city."

Here Jonathan's artillery consisted of a bow and few arrows. Later, when siege engines were introduced, artillery included "*bambards*" (stone-throwing siege engines), *kapringal* (large wall-crossbow) and so on. Ultimately, when gunpowder weapons were developed cannon was also called a "bambard." Similarly, the Sanskrit *mahasara-yantra* and *satagni*, the Arabic *manjaniq* and *sang-i-maghrabi*; The *Mamluk midfa and midfa an naft*; and the Chinese *hua ch'iang, p'ao* and *tuyan de feu* were names of siege engines that mechanically hurled large stones and incendiary and explosive materials. It is difficult now to ascertain when these names ceased to mean mechanical devices and were exclusively applied to gunpowder weapons.

The Arabic or Persian word *banduk*, plural *banadik*, for example, originally meant filberts, an oblong edible fruit, or its nut, or the plant itself, of cultivated European hazel (*corylus ovellanic*), believed to have been used in Venice (*banadik*, corruption of the German *venedig*). Later, the word meant a pellet of a pelletbow/stonebow and then the pelletbow-ellipticall or *kaus al'b'r pelletbow*. According to Burton (translator of Arabian Nights), Al Bandukani, the man of the pelletbow, was one of the names by which the Caliph Harun al Rashid was known, and Al ZahirBaybars al Bandukdari, the

fourth Baharite Soldan (1260–1277 A.D.) was so entitled because he had been a slave to a *bandukdari*. When the crossbow was introduced it was also called a *banduk* and ultimately the term was applied to a matchlock musket.

Apart from literary sources, the best unimpeachable evidence about the early use of gunpowder weapons in the past is the surviving example of antique firearms, which is either dated or at least dateable with reasonable certainly. Inscriptions, ornamentation and decoration styles found on them generally throw light on their period of use and countries of origin. However, such the fourteenth-century examples of firearms or earlier are extremely rare. The few hand cannons of the fourteenth century, held in foreign museums, are mostly excavated pieces or those fished out of the sea and could only be dated approximately. Indian examples of this period are not yet discovered and the few cannons are mostly of the fifteenth century.

Strangely enough, the royal Indian, whose ancestors are believed to be the inventors of gunpowder and gunpowder weapons, faced utter defeat and shameful disgrace at the hands of the Mughal conquerors who ruled for well over three centuries. The reason was that Indian armies did not use gunpowder weapons. Undoubtedly, this is the price paid for resisting the ascendancy of the infantry over the cavalry by not adopting the gunpowder weapons soon after their invention.

It is strange that the people who may well have been the originators of the firearms did not realize the power and potentialities of the new weapon. It was the disaster at Panipat that made them realize the dangers of their almost total dedication to sword and spear.

3.1 Indian Sources

The hypothesis that gunpowder was known to the ancient Hindus was first mentioned in the eighteenth century by some Sanskrit scholars. The most ardent protagonists were an Englishman, Nathaniel Halhad, a German, Johann Backmann, a Scotsman, Quintin Craufurd and another German, Gustav Oppert. It is a fact that ancient Indians developed their own special

techniques in the field of metallurgy, alchemy, medicine, astronomy, mathematics and so on. For instance, the process for extracting and refining saltpeter, the knowledge of certain plant materials to make special grades of steel suitable for producing arms and armor, and the use of plant derivatives for pharmacological purposes are Indian discoveries. It seems that the Indians knew about saltpeter from ancient times, and the other basic ingredients – sulfur and charcoal – were the easiest to procure. It is, therefore, very likely that gunpowder, at least the proto-gunpowder, was discovered in India.

Halhad[19], cited references in his work in the preface of his work mentioning that gunpowder was known to the Indians from the very early days. But one renowned arms historian cast doubt on the authenticity of the evidence brought out by Halhad and said that "Careful examinations of his work reveals the skillful doctoring by the translator to establish his own case."

Backman[20], mentions; "I am more than ever in inclined to accede to the opinion of those who believe that gunpowder was invented in India and was brought by the Saracenes from Africa"; the Saracenes (nomadic Syrian Arabs of the Crusades) from Africa to the Europeans "who, however, improved the preparation and found out different ways of employing it in war small arms and cannons."

Oppert translated ancient Sanskrit manuscripts and also published a book on the *Weapons, Army Organization and Political Maxims of the Ancient Hindus*, with special reference to gunpowder and firearms. Bhatia[21], quoting Oppert's book records stated "The ancient Hindus not only knew from the earliest period about the use of explosive powders for fireworks and for discharging projectiles, but also made clay elephants that were exploded from a distance with a fuse to destroy an invasion"; Alexander as well as Tamerlane had faced such devices in India.

Oppert's main sources were some ancient Sanskrit text such as *Nitiprakasika, Nitishastra, Sukraniti*, *Atharvana-Rahasya, Mahabharata*. Unfortunately, his hypothesis cannot be fully sustained and the original references in Sanskrit could not be located to date these sources correctly. Blackmore[22] very aptly summarized Oppert's theories: "as many statements in his book are palpably absurd – the size of the Akauhini Army corps is given as 2,187,000,000 men – and no proper attempt has been made to date the sources, Oppert's theories cannot be accepted."

No doubt that these statements are gross exaggerations, but this is not very unusual and many famous works by renowned authors of the medieval period also contain such remarks. For instance, Roger Bacon says in his much quoted work *Opus Majus*: "…sounds like thunder and flower in the air can be made by means of a rightly prepared material no bigger than the thumb, which can destroy whole cities and armies." What a grossly exaggerated capability of a mere firecracker! Can the entire work of Bacon be disregarded because of this statement? Oppert and Bacon were writing about a period in an era when myth, history and philosophy, science were not yet separated and their sources were also rather vague ambiguous. However, they did give us very valuable material as food for thought.

Peterson[23] records: "Saltpeter was probably known fairy early in India and hence it light have been expected that gunpowder was discovered there." The dating of Sanskrit works is mostly difficult. Supposed references to gunpowder are now recognized as unauthentic. Two Sanskrit works *Sukraniti and Nitiprakasika*, which describe gunpowder and firearms, have been used as early sources of information, but there is every reason to think that they were used by relatively recent scholars as sources of information. Some of the content resemble that found in the Wu Ching Sung Yao and the probability that some material was borrowed from the latter source cannot be ignored. Too little research has been done on both. Chinese and Indian sources do not allow any great feeling of satisfaction concerning knowledge of either works, and the works were translated by students not sufficiently

acquainted with military and technical information. In the case of Chinese works, wrong technical terms have been used in translations.

In the existing transcriptions of some ancient Sanskrit works, such as *Nitiprakasika*, *Sukraniti, Atharvana-Rahasya, Agnipurana, Mahabharata*, some highly combustible and explosive mixtures are mentioned while describing pyrotechnic or fire weapons. The *Sukraniti* believed to be written by Shukracharya[24] (c. 200 B.C.) speaks of *agnichurna*, literally fire powder; the *Mahabharata*, believed to be written by an ancient sage Vyasa[25] about 2,000 years ago mentions *agneya-aushadha*, literally fiery chemical or fiery medicine. Both were undoubtedly either highly combustible substance, or explosive mixtures, or chemicals – possibly proto-gunpowder. The only proof now required to show that any of these powders are gunpowder is that it contained saltpeter in addition to sulfur and charcoal. Oppert[26] was perhaps one of the earliest scholars to locate the Sanskrit work *The Rajalakshminarayana Hradaya*, part of *Athavana-Rahasya*, as a proof of the facts that the ancient Hindus were familiar with gunpowder; "As the fire prepared by the combination of charcoal, sulphur and other material depends upon the skill of the makers…" Here the saltpeter is deliberately left out to keep the composition a secret. Such compositions of firearms continued to be used throughout the Middle Ages. Even Rogger Bacon while giving the composition of gunpowder in the mid-thirteenth century mentions charcoal as an anagram

which Col. Himes[27] rearrange to mean "charcoal."

"Ingalagandhadi pathartha-yogat

karturmani sanuguno yathagnih"

In the same work elsewhere, Bacon, while describing gunpowder mentions the anagram

"Puro Vopo Vir Can Utrict"

The above text was translated to mean Willow Charcoal.

Gode[28] was one of the few Indian scholars who investigated almost all available Indian sources about the use of gunpowder and concluded that the earliest dateable evidence occurred in the accounts of Abdur Razzaq, a Persian ambassador of Sultan Shah Rukh. In this account, Razzaq mentions about his visit to the Vijayanagara Empire in 1443 A.D., during the reign of Devaraya II (1426–1446); he saw the pyrotechnic display in the capital during the Mahanaomi celebrations. Gode rightly presumes that gunpowder must be obviously known in south India by the fifteenth century, as fireworks were already in use. Needless to say that by this date gunpowder was in general use in many other parts of the world, more so in China, the Arab countries and Europe.

Gode's[29] accounts of Mahmud Gawan in his second campaign of Belgaun in 1472 A.D. and accounts by Sherwani[30] and Farista[31] on *Burhanu-i-ma'athir*[32] state that "…mines are laid under the wall of the fortress of great strength (Belgaun), under a cover of a new wall erected parallel to the former and as this laying of mines is entirely new thing in the Deccan, the *Rai* (the defender of the fortress) was not aware of the significance of the new wall being created. Anyhow three mines, those from the posts of Khwajah Yusuf 'Adil Khan and Fat-hu'llah 'Imadu'lmulk burst open the wall and breaches are affected." Gode also states that the use of mines presumes the importation of gunpowder or its manufacture in India, and could have been carried out in the fifteenth century in Gujarat, Deccan or Vijayanagara.

By the last quarter of the seventeenth century gunpowder was known in the peninsular India (Maratha period) as *daroo*. The Sanskrit term *naamagni-churna* was another explosive powder mentioned in some Indian chronicles, which was most probably powder. In the first half of the eighteenth century, the word *daroo* was continued to be used in some Sanskrit works and by the third quarter of this century another term *gulikangra-churna* (most probably signifying biggest grained or granulated gunpowder) appears in some Sanskrit works, which appears to be special gunpowder used for cannons. By the last quarter of the eighteenth century,

however, two specific types of *gunpowders* are mentioned – *top-i-daroo* and *bandook-i-daroo* – one for cannons and the other for muskets.

The Indians used musket and this certainly points to the use of explosive powders or fiery chemicals – proto-gunpowder. The missiles carrying inflammable explosive material were launched by mechanically operated devices for setting fire to enemy installations and equipment or to cause confusion in the enemy ranks by loud explosions. Whether any one of these powders was true gunpowder in the modern sense of is not yet certain.

However, so far no one has examined the Indian annals of the period tenth to thirteenth centuries to locate possible references to true gunpowder and, therefore, it cannot be concluded that it was not known in this period.

Mohammad Ibn Kasim invaded Sind in A.D. 93 (711–712 A.D.) and he used *naft* arrow in 1008 when Mahmud Ghazni attacked Jaypur, near Peshawas. They were fire weapons (fire arrows) carrying incendiary material.

In the Sultanate period (1206–1290) following the death of Mahammad Ghori, Ranthambore was attacked by Iltutmish in 1226 and again by Alla-ud-din Khilji (1291–1316) in 1299. Some historians are of the views that in these battles, the attackers used siege craft, a proto-cannon. It is more likely that what they used were siege engines worked by proto-gunpowder to launch large rocks, balls of metal and stone, heavy spears and so on, to knock down the fort wall or gates.

Oppert said: "The oldest document mentioning and describing gunpowder is found in India and written in Sanskrit and that the use of gunpowder and its application to the discharge of missiles for projectile weapons was a well-known fact in ancient India." No Chinese work on this question can, with respect to antiquity can be compared with *Sukraniti*, so that even if the Chinese should have independently invented gunpowder, "the claim as to priority of invention will certainly remain with India."

In the *Sukraniti*, the following verses speak about the composition of gunpowder: sloka/(lines); 141 (280 and 281), 142 (282–284), 143 (285 and 286), 146 (291 and 292), 147 (293–294), 148 (295–296), given both in Sanskrit and its translation. *Agnichurakam*, the term used for gunpowder, is (*agnichurakam or agnichuranam*) in sloka 268 (line 534) and the term *natagnchurn* (fire powder), the main ingredient, is mentioned. *Suvarcilavana* (shining salt-saltpeter), *gandhaka* (sulfur) and *arakasuk yadyangara* (charcoal of *Calotropis gigantea*), *Euphorbia neriifolia* and other plants. Verse 141 gives the proportion by weights. 5:1:1, respectively.

It seems to be a strange coincidence that the Wu Ching Sung Yao, a component of Chinese Military applications in 1620s gives the recipe for "fire powder" (likely to be *agnichurana*) with exactly the same proportion (5:1:1) of sulfur, saltpeter and charcoal.

Verse 141 gives the proportion by weights 5:1:1, respectively. Verse 146 says that 6 or even 4 parts of saltpeter may be used for tubular arms (guns), but parts of sulfur and charcoal remain the same. Other ingredients of gunpowder are given on verses 146 and 147: red arsenic sulfides, mansil yellow chromic sulfate[9] and orpiment (*harital*), *sisamalasyn* (graphite), vermilion (*hingula*), powder of magnetic iron oxide (*kanalaraja*), camphor (*karpura*), lac, (*cajalornilya*), indigo (*sanalaniryasa*) and pine gums (*Pinus longifolia*).

The method of preparing the mixture is to powder the components individually, mix them together, add the juice of *Calatrophia gigantean*, *Euphorbia neriifolia* to *Allium sativum*, dry in the sun and grind the dried mixture to the consistency of sugar. These ingredients are also found in the Chinese gunpowder known as *hua yao*. This recipe is given in a Chinese military treatise – *Wu Ching Tsung Yao*, set to be compiled in c. 1040 A.D. of which on a fifteenth-century copy is now available. This indicates that the Chinese had borrowed the recipe from India.

3.2 The Chinese Sources

Copies of manuscripts and treatises that were reproductions of nonexisting originals and publications containing information based on earlier sources are frequently quoted by the Chinese protagonists. Two such compilations are the *Wu Ching Tsung Yao* and *Wu Pei Chih*. The former is a military treatise believed to be complied in c. 1040 A.D., but only the fifteenth-century copy of it is now available. This version of *Wu Ching Tsung Yao* contains some pictures of cannon, which were already in general use in the fifteenth century. Because no descriptions of the cannons are given in the texts, it is quite probable that these pictures were interpolated when this treatise was reproduced in the fifteenth century. This treatise mentions explosive – probably a proto-gunpowder – known as *hua yao*. Peterson[33] records reproduced work for the proto-gunpowder, which were quite complicated:

"Grind together with a pestle and sift 14 oz. of *chinchou* sulfur, 7 oz. Of K's sulfur, 2.5 lb. Saltpeter. Grind together 1 oz. *realgar* (red arsenic sulfide, in Hindi – *mansil*), 1 oz. *ting powder* and 1 oz. *massicot* (lead oxide). Powder 1 oz. dry lacquer. Roast to bits or powder 1 oz. hemp roots, 1 oz. bamboo roots. Boil to paste 0.5 oz. beeswax, 1 oz. clear oil, 0.5 oz. *ung* oil, 14 oz. pine pitch, 0.1 oz. heavy oil. Mix all together evenly, blind with hemp, smear the pine pitch and throw by a catapult." Peterson records that this is an incendiary missile, even though the fuse to ignite it is absent. It is obviously an explosive missile that exploded when struck against a hard surface, such as a fort, wall, or gate. The explosive mixture enclosed within the missile. But this complicates the issue further as the mixture will be exploding due to percussion, and percussion powders were definitely not known in Europe in the fifteenth century.

Peterson specified that saltpeter, sulfur and charcoal with various resins, oils, wax, etc. were mixed and smeared over a ball and hurled to make a rumbling noise, flames and smoke – obviously an incendiary missile.

The other Chinese treatise, *The Wu Pei Chih* is a compilation of military appliances apparatus and explosives. It is believed to be written by a military

expert and was first published in 1621 (according to Peterson[34]) or written in 1628 (according to Blackmore[35]).

However, it is believed that the work is based on earlier sources, which are not available now. Peterson[36] records stated: "Like most Chinese works it begins with a legendry history attributing inventions to mythical emperors or officials of the remote past, and European translators of Chinese works were seriously misled in taking this information at its face value. They stated, for example, that gunpowder and firearms were known in China before the beginning of the Christian era."

The Wu Pei Chih also contains many recipes of proto-gunpowder, which include not only saltpeter, sulfur and charcoal but also many other organic and inorganic substances. For instance, Blackmore[37] mentions that the *fa* powder contained saltpeter, sulfur, charcoal white arsenic, stone coal, four varieties of ginger, various bitter substances and human sperm.

Peterson[38] also reproduces some work from *The Wu Pei Chih*:

"Fire-powder: Saltpeter 5 lbs. Sulphur 1 lb., Charcoal 1 lb. (Which is a very good composition) Grind well, moisten with spirits and shape into pellets."

"Lead powder Purified Saltpeter 40 oz., Sulphur 6 oz., Calabash or egg-plant stalk charcoal 6 to 8 oz. Grind well with a little water and dry in the sun. It is useful to add a spider skin."

"Cannon powder: Saltpeter 10 oz., Sulphur 6 oz., calabash or Bamboo charcoal 3 oz., orpiment (yellow arsenic sulphide) 1 oz. and realgar 0.5 oz."

Peterson said: "In the accounts of 1132 a fire lance apparently containing an incendiary powder is mentioned, in 1221 what is called a '*bomb*' of pig iron which exploded like a thunderbolt, and in 1259 a Bamboo tube containing powder and bullets. These suggest that some kind of explosive powder was known to them. We are now getting near the time when gunpowder was known is Europe."

According to Partington[39], who had examined almost all available Chinese sources, concluded that weak gunpowder was known to the Chinese by the beginning of the eleventh century. It was not powerful enough to be used as a propellant and was used as a weak explosive in pyrotechnics (fireworks). By 1130, the Sung period in which the *Wu Ching Sung Yao* was compiled, long bamboo tubes were filled with explosive powder (*hua ch'ang*) and were used as offensive weapons. Such pyrotechnics were mainly used as psychological weapons – the flash, smoke and bang to frighten the enemy and the horses and elephants on the battlefield.

3.3 The Arabic Sources

Peterson[40] said: "It appears that the knowledge of Saltpeter and its use in making incendiary compound originated in China soon after 1000 A.D. and passed to the Arabs. True gunpowder was known to the Chinese only in the Mongol period and may have been discovered in Europe between 1225 and 1250, although the evidence for this is lacking."

To appreciate the Arabic source a brief history about the rise of the Islamic nations may be useful. Mohammad, the Prophet, was a Bedouin leader born in 570 A.D. in the Arabian city of Mecca. He preached a new religion, Islam, faith in the one true God, which the Arabs (one of the Semitic races inhabiting the Arabian Peninsula and some neighboring countries) embraced and became Muslims.

The neo-Muslims, with the purpose of spreading Islam, attacked some counties of Asia and Europe and within a few years spread Islam far and wide. Every Muslim was an enemy of the nonbelievers (*kafirs*) and a vast empire supported by a powerful navy was created in a record period. The Arabs became the masters of the vast Islamic Empire: Persia, Mesopotamia, Syria and Egypt, parts of Central Asia, North Africa and Spain. The Islamic era started from 622 A.D. and is called *Hijiri*.

Wella said[41]: "Advance of the Moslem army was the most amazing story of the world. After defeating the Byzantine army at the Battle of Yarmuk in 634,

they overran Syria, Damascus, Antioch and Jerusalem and then they turned east. Ultimately Persia was conquered and the Moslem Empire pushed far into Western Turkestan and eastward until it met the Chinese. Egypt also fell without resistance. The tide of conquest along the north-west coast of Africa to the straits of Gibraltar and Spain. Spain was invaded in 710 and in 732 the Arab advance reached the centre of France. Here the Arab advance was stopped for good at the Battle of Poitiers at the hands of Charles Martel. The great Arab Empire stretched from Spain to China with its capital at Damascus."

The rise of the Muslim navy, operating from the Syrian ports, cutoff the Mediterranean routes, which were the main arteries of commerce between Europe and southeast Asia. More dangerous still was the seaward advance of the Arabs toward Constantinople, the most important center for distributing the goods brought from India and the southeast Asia by the European traders.

The Arabs captured Rhodes and Cyprus first and then launched a five-year blockade of Constantinople (674–678). The repulse of this formidable thrust, with the aid of the deadly Greek fire, marks the turning point in the Byzantine naval history. This appears to be the first example of the use of Greek fire by the Arabs, an incendiary device. The formula was a closely guarded secret from the time of its invention about a century earlier[42].

There were three important highways of commerce, which was used for trade, since the beginning of the medieval period. The first one was through Afghanistan, Central Asia and terminated at the Caspian Sea. The second route was through Persian and Syria, leading to the port of Alexandria, on the Mediterranean coast of Egypt. The third rout was mostly by sea. Ships carried goods through the Arabian Sea, the Persian Gulf and the Red Sea. Then they were taken by land to the port of Alexandria, and the merchants of Venice and Genoa carried them to the European markets. The last two routes were virtually closed in the seventh century when the Arabs conquered this region and the trade passed into their hands.

Arab ships were trading with India even before the birth of Mohammad. Later, many Muslim merchants made their homes in the western coast of India and settled down as peaceful traders. However, soon after conquering Sind and Multan, the Arabs not only continued but also developed commercial traffic by the sea routes as well as by the overland trade routes, and established trading relations with China, Africa and Europe.

The tales about the riches of India ultimately reached Arabia and attracted greedy trades – of course on the pretext of spreading Islam – to intrude into India. The first Muslim to invade India was Mohammad Bin Quasim, an Arab chieftain, who conquered Sind and Multan in 712 A.D. Nevertheless, according to the historian Poole[43], and quoted earlier by Pant[44], archery was the main weapon of the first Arab invaders and they used *naft* arrows in battles during their invasion. The Hindu army, under Dahir, the ruler of Sind, used many elephants in the battle, which was normal in this period. Mohammad Bin Quasim made his archers to shoot *naft* arrows to set fire to the Howdas of Dahir's elephants and brought disorder to their ranks, and as a result the Hindu army was routed and massacred. Perhaps this is the first mention of incendiary arrows used by the Arabs against Indians. According to Blackmore[45], the *Mamluk* word *naft* which can be translated to mean a gun, or gunpowder, or other incendiary materials, and it is by no means certain when this word ceased to refer to an incendiary material and instead meant gunpowder.

The cultural effects of the Arab influx into India after Mohammad Bin Quasim's invasion of Sind were that many Arab scholars visited Sind. Many Sanskrit books on Astronomy, Medicine, Mathematics, Philosophy, etc. were translated into Arabic. They also learnt the numerals, particularly the application of the numeral zero, which was not yet known in the west, and they passed on this knowledge to the Europeans. The Arabs also took keen interest in the Greek, Persian and Indian scholars.

According to Wells[46], in the ninth century, Arabs learned in the schools of Córdoba in Spain and were corresponding with learned men from Cairo,

Bagdad, Bokhara and Samarkand. Very great advances were made in mathematical, medical and physical sciences. The clumsy Roman numerals were ousted by the Arabic figures and we use it to this day, and the zero was first used. The words algebra and chemistry are Arabic. The Arab philosophy reintroduced the medieval philosophy of France and Italy to the entire Christian world. They came upon many metallurgical and technical devices of great value; alloys and dyes, distilling, tinctures, essences and optical glasses.

Krum, the aggressive Bulgar Khan, took the Byzantine city of Mesembria and captured the dreaded Greek fire and some bronze tubes for use on November, 812 A.D.

While the Arabs prospered and flourished, Europe had declined in almost all respects. Their trade suffered and learning became limited to the Church and monasteries. These conditions prevailed until the eleventh century, and this period is, therefore, called the Dark Ages of Europe.

The Christians and Muslims soon got involved in a series of confrontation, known as the Crusades. Although the Christians could not win the campaigns, it brought them closer to the Arabs and an opportunity arose to exchange information on a larger scale.

The Arabs and their tribes, such as the Saracenes[47] and Moors[48], seem to have played bigger roles in the history of development of gunpowder and in sharing this knowledge with the western world. It is obvious that this knowledge about the composition and its properties powers, invented in China or India, reached Europe by the third quarter of the thirteenth century, and it is believed that some Arab scholars brought this knowledge to Europe. Although the exact detail of how it reached Europe is obscure, Bacon's treatises indicate that the Europeans knew about it by the third quarter of the thirteenth century. According to Balckmore[49], this hypothesis is supported by an Arabic manuscript of the fifteenth century, formerly in

the Museum Asiatic in St. Petersburg. The original composition of this manuscript has been dated between 1300 and 1350 A.D.

Peterson[50] records that an Arabic manuscript of about 1225 A.D. describes incendiary compositions, but not gunpowder. A work by Hasan Al-Rammah, probably written in about 1280 A.D., quotes earlier authors, describes the purification of saltpeter, and gives many compositions of fireworks which are described as Chinese. It does not describe gunpowder, although it describes the use of gunpowder as a propellant. Some of the soldiers in this work bear Mongoloid features and the incendiary and fire weapons illustrated are reminiscent of the Chinese treatises *Wu Ching Tsung Yao* and *Wu Pei Chih*, mentioned earlier. Both gunpowder and cannons were known by this period as gunpowder and was mentioned by Bacon in 1267 A.D., and an illustration of a gun, in the form of an illumination, is shown in an Oxford manuscript of 1326 A.D.

According to Oppert[51]: "There exist an old traditions, according to which the Arabs possessed, at an early date, a knowledge of the manufacture of gunpowder, and that day obtained it originally from India, with which country they had an active commercial intercourse. They even said to have improved on the original manufacturers. That the Arabs received their earliest gunpowder supplies from India and that this country was the original seat of its invention was very strongly urged as early as the end of the Eighteenth century by M. Langes in a paper red to the French Institute in 1789."

3.4 The European Sources

Scholars examining the European sources determine the date, or period, when gunpowder was first known in Europe. They had problems in (1) locating the extremely rare and dated, or dateable, sources of the eleventh century or earlier works; (2) isolating subsequent interpolations in documents said to be copies of nonexisting originals; and (3) detecting anachronisms in the available European sources.

For instance, as Smith[52] correctly pointed out, it is possible to extract sentences in Plutarch's life of Marcelious and Vitruvious to interpret that Archimedes (827-212 B.C.) knew about gunpowder. Valerious Falcus, a Roman authority, can also referred to show that the Brahmins, of ancient times, tried to reproduce thunder. In the Aneid, Virgil tells us of a similar attempt by *Salmonenious.* However, modern arms historians, after examining almost all European evidence available, have come to the generally acceptable conclusion that true gunpowder was neither known nor was used in Europe before the thirteenth century.

Smith[53], who examined such negative evidence, mentions some authentic references in his massive compilation to highlight the above conclusion. He cites the work, a history of the Roman European Alexius I (1081–1118 A.D.), by his daughter Princess Anna Kruma.

This work is generally accepted by historians as a reliable source of data on the First Crusades and the contemporaneous history of the Byzantine Empire during the reign of Alexius I. In this work, she mentions some formulas of Greek fire and other incendiary but nothing about explosive mixtures containing saltpeter.

Smith[54] also cited the records left by Glovanni di Plan Carpin, a scholar and veteran soldier, commissioned by Pope Innocent VI in the year 1246 to travel to the court of Genghis Khan, the Mongol conqueror, at Karakoram. Having gained the admiration of the Khan, Carpin was able to observe Ghengis Khan's campaign against the Chinese. He wrote a detailed account of the famous siege of Kai-Fung-Fu, the capitol of Hanoi province, in which he systematically described every type of weapon he came across. He mentions about the use of ballista, the artillery of the day, which included many varieties of sling and bows, and also described some types of Greek fire. In his descriptions of assaults he mentions the burning of Chinese cities.

A Franciscan Monk, Berthold Schwardz, whose real name was Constantin Anchlitzen or Anklitz but popularly known as der Schwarze Barthel, made

gunpowder at Freiburg in the Briesgan about the year 1330.

He dabbled in alchemy and was very fond of experimentation in chemistry; he was blown up and nearly killed by an explosion of the mortar he was experimenting upon. Eventually, he was accused of practicing magic and necromancy and sent to prison. A grateful posterity, a statue was erected in his honor on the spot where the Franciscan Convent of Freiburg had once stood; an honor which he may have richly deserved for many reasons, but surely not for being the original inventor of gunpowder.

Many years earlier to Berthold Schwardz, another Franciscan Monk, Rogger Bacon (1214–1294), the doctor mirabilis of Oxford, had already pointed out the peculiar qualities of saltpeter, as exemplified in the action of gunpowder. Like every chemical scholar of those times, he became an object of clerical suspicion, was incarcerated by his superiors on the plea of practicing forbidden magic, and though, for a time, released by Pope Clement IV, he was again imprisoned under Pope Nicholas III. Bacon suggests that gunpowder should be used in war as it would supply a powerful means for destruction of hostile armies. He notices particularly thunder-like noises and lightning-like flash at the time of explosion; its application to cracker and fireworks is a subject he was well acquainted with. He states in his book on the *Secret Works of Art and Nature*, the principal ingredients that make gunpowder, saltpeter and sulfur, but did not wish to make the secret known. He uses instead an obscure expression.

"i lura nope cum-ubre, which had been later ingeniously

(-luro vopo vir cary utriet)

(Found out to stand for "carbonium pulvere" (charcoal powder)

(sed tamen Sali pctrae, lure nope cum-ubre et

Sulphuris, et sic facies tombrum et coruscitionem, si scias artificum)"

In Roger Bacon's work *De Scratis Opperitus Artis Et Nalurae Et Des Nullitate Magiae* at another place he alludes to fireworks; "*Ex hoc ludicro*

pueriti quod fit in muths nundi partibus scilicet ut instrumento facto ad quntitatium pollices humani ex hoc violentia salis qui salpetrae vocatur tam horribilis sonus nascitur in ruptura tam modicae pregamenae quod fortis nutritum et caruscation em maximas sui luminis jubaar excerit."

The first use of true gunpowder in England was in 1327 in the war against the Scots by Edward III and was known as "crake," which may be a correction of cake gunpowder that was imported from abroad until the reign of Elizabeth, when the English powder rites were established in England.

[19] Halhad, N. *Gento Code*, tr. East India Company, 1776.

[20] Backman, J. *History of Invention and Discovered*.

[21] Bhatia, H.S. *The Civil and Military Low Journal*, New Delhi; *Hindustan Times*, 7 October 1980.

[22] Blackmore, H.L. *Guns and Rifles of the World*. London, 1965, p. 1.

[23] Peterson, H.L. Encyclopaedia of firearms. *The Connoisseur*, London, 1964, p. 49.

[24] Shukracharya. *Shukraniti, the Elements of Polity of Shukracharya*. Vidyasagara, Verse 202, 0.555.

[25] Vyasa. Mahabhartha. Chtrasala Edition, Pune, 1929, p. 17.

[26] Oppert, G. *On Weapons, Army Organisation and Political Maxims of Ancient Hindus, With Special Reference of Gunpowder and Firearms*. London and Madras, 1880.

[27] Himes, H.W.L. *Gunpowder and Ammunition, Their Origins and Progress*. London, 1904.

[28] Gode, P.K. *Use of Guns and Gunpowder in India, From* ***A.D.****1400 Onwards.*

[29] Gode, P.K., op. cit., p. 3, fn. 1.

[30] Sherwani, H.K. *Muhmud Gawan's Campaign in Maharashtra*. p. 263. *The Journal of Indian History*, Madras, Vol-XVI, p. 363.

[31] Farishta. *History of India*. Written in the times of Ibrahim Adilshah 1579–1626.

[32] Published by the Persian Texts Society, Hyderabad, Andhra Pradesh.

[33] Peterson, H.L. Encyclopaedia of firearms. *The Connoisseur*, London, 1964, p. 149.

[34] Peterson, H.L. Encyclopaedia of firearms. *The Connoisseur*, London, 1964, p. 49.

[35] Howard, L. *Blackmore, Guns and Rifles of the World*, London, 1965, p. 2.

[36] Peterson, H.L., op. cit., p. 149.

[37] Blackmore, H.L. *Guns and Rifles of the World*, London, 1965, p. 2.

[38] Peterson, H.L., op. cit., p. 149.

[39] Partington, J.R. *A History of the Greek Fire and Gunpowder*. Cambridge, London, 1960.

[40] Peterson, H.L., op. cit., p. 150.

[41] Well, H.G. *Short History of the World*. London, 1970, p. 170.

[42] *The Cambridge Medieval History*. Vol-IV, *The Byzantine Empire*, Pt.I, *Byzantine and its Neighbours*, p. 25.

[43] Lane Poole, S. *Medieval India*, p. 9.

[44] Pant, G.N., op. cit., p. 46.

[45] Howard, L. *Blackmore, Guns and Rifles of the World*, London, 1965, p. 3.

[46] Wells, H.G., op. cit., p. 172.

[47] A Syrian or Arab nomad, a Muhammadan, an opponent of the Crusaders.

[48] A non-Christian, a Muslim of the times of the Crusades, a member of the mixed Berber and Arab people of Morocco and Barbary coast; one of the Arab and Berber Conquerors and occupants of Spain from 711 A.D. to 1492 A.D.

[49] Howard, L. *Blackmore, Guns and Rifles of the World*. London, 1965, p. 3.

[50] Harold, L. Peterson, op. cit., 149.

[51] Oppert, G. *On the Weapons, Army Organization and Political Maxims of the Ancient Hindus. With special reference to Gunpowder and Firearms*. Madras and London, 1880.

[52] Smith, W.H.B. *Arms of World*. 1962.

[53] Smith, W.H.B. *Arms of World*. 1962.

[54] Smith, W.H.B. *Arms of World*. 1962.

Chapter 4
Siege Craft or Siege Engines

The introduction of projectile weapons, particularly the longbow and the crossbow, on offensive tactics of warfare naturally resulted in the development of a new defensive strategy. Defended localities were built in almost all important settlements to give protection in the case of sudden or unprovoked attacks by an enemy: they included well-defended localities such as castles, essentially bases for defensive, as well as offensive operations in the field and where fortresses and forts were built from at least the tenth century B.C. in China, the Great Wall of China till date, and from about the fifth century B.C. in Europe. In India, traces of ancient fortifications could be seen in the excavation sites of Harappa. By about the early medieval period, fortresses were usually built on high but accessible ground. People who were more defensive in nature built them in an accessible spot as hill tops to make it difficult for besiegers to assault, forgetting that it made the task of the defenders' retreat also improbable as any fort could easily be blockaded and all essential supply cutoff, and the besiegers could also effectively cutoff all routes of supply.

Besiegers of such fortifications naturally devised suitable siege craft such as scaling ladders, battering rams and siege towers. In turn, the fortresses and castles were built with stronger and higher walls and the siege engine weapon was also made longer, heavier and cumbersome, and when they could not be made any bigger, tunnels were built. Also, deep excavations and wide moats around ramparts of castles and fortresses made tunneling through the walls a very slow, difficult and tedious process. The moats also made it increasingly difficult to use the above siege craft as the assaulting

forces could not easily approach defended localities without the defenders coming to know about their maneuvers. The best way for assaulting forces to enter a fortress was either to breach or destroy the massive walls by mechanically operated siege engines capable of knocking big holes in the walls, or break them down, or shoot objects over them, from a distance. The trebuchet or mangonel was introducing manjaniq and sang-i-maghrabi.

The natural step was to enlarge and modify the already popular portable projectile weapons, such as slings, bows, catapults and so on, so that large missiles could be launched to smash fortifications, which could be classified as siege engines – the artillery of the day. According to Brent[1] siege machinery were developed from at least the tenth century B.C. in China and from about the fifth century B.C. in Europe. He also mentions that Genghis Khan made his soldiers learn the techniques of using siege engines from the Chinese (about mid-thirteenth century).

The earliest siege craft was, perhaps, a simple wooden beam, such as a trunk of a big tree, with which the besiegers rammed the gates and walls of fortifications manually. Elephants were also used instead of manpower to batter down such obstacles and were common in the medieval period. The battering ram was a modification of the simple beam in that it was tipped with sharp metal points to simplify the battering operations. The "karak" almost all portable projectile weapons of the infantry were enlarged and modified by the artillery commander for smashing fortified positions such as forts. Such weapons are generally known as siege craft or siege engine. They were used extensively by Indian commanders just like others such as the Chinese, Mongols, Romans, Greeks and so on, as the first millennium B.C. The battering ram was perhaps the simplest among these and consisted of a heavy log of wood tipped with metal spikes. Soldiers held it over their shoulders and hammered gates and walls of fortresses and castles to smash them or to make a passage for the rest of the infantry to enter. Pant[55] mentions that the weapon *parigha* mentioned by Kalidasa, in his work Raghuvamsha, was a battering ram used as a siege craft. He also observes

that the weapon *sataghui*, meaning a killer of 100 persons, was a large mobile siege craft for hurling stones. He also remarks that the weapons *mahashilakantaka* and *rathamusala* used by King Ajatshatru of Magadha were also large stone-hurling siege craft. However, as usual, no descriptions of these siege craft are given in the early Sanskrit sources.

The European sources specific while describing their versions of siege craft, such as the mangonel trebuchet, espringal, bambard and others.

4.1 The Espringal

The espringal (Fig. 4.4(a)), or the wall-crossbow, was merely an enlarged version of the hand crossbow. It fired heavier quarrels or large balls of stone to break down enemy strongholds such as gates fortresses and castles. They were also mounted on walls of forts or platforms and used as defensive weapons to ward off enemy attacks. Kautilya[56] mentions a large machine – the *mahasara-yantra* – believed to be a wall-crossbow. Kalidasa[57] also mentions large bows so heavy that they required a number of men to move them – obviously they were wall-crossbow.

The Roman siege engines of the crossbow type – the so-called Ballista or Arbalests used by them extensively in their campaigns. Javelin-like quarrels were shot from them up to an effective range of about 275 meters. Blair[58] says that it is from this term, the medieval weapons *arablest* in French and *armbrust* in German were derived. Compton[59] mentions that the Indian *sangrad* was a stone ball fired from wall crossbows.

According to Brent[60], siege machines were developed from at least the tenth century B.C. in China, and from c. 500 B.C. in Europe. He also mentions that Genghis Khan made his soldiers learn the techniques of using siege craft from the Chinese.

As castle and fortress walls were made higher and stronger, in the medieval period, the old methods of attacking by scaling ladders, siege towers and tunneling became ineffective. The scaling of siege tower became long, heavy, cumbersome and hazardous; tunneling became a slow and

tedious process and battering became less effective. It was increasingly difficult to get them close enough to the walls and gates. The only solution was a mechanically operated projectile weapon designed to break walls of forts or shoot objects over them, whether a rock, incendiary object, or occasionally a combatant. Solid missiles were shot so that a big hole was knocked in the enemy fortification, with some kind of missile so that the assaulting forces could enter the fort quickly. Other weapons included large catapults and crossbows discharging from handed quarrels, or stone missiles, or inflammable material, such as the Greek fire. Before the invention of gunpowder such mechanically operated siege craft comprised the artillery of the day. The *ballista* used widely in Europe for hurling large stone missiles was an important piece of artillery, particularly during the period c. 1000 A.D. to 1200 A.D. The biggest siege engine was the onager. Like the ballista and the large catapult, it was built of wood and the firing principle was the same in each case – a twisted skein suddenly released.

4.2 The Bambard

The *bambard* was a stone-throwing machine used for attacking fortified positions in Europe up to the fifteenth century (Fig. 4.1(a) to Fig. 4.1(e)).

4.3 The Mangonel

The *mangonel*, a form of a large catapult had a long wooden arm that was kept under tension by a twisted skein of sinew or rope (Fig. 4.2(a) & Fig. 4.2(b)). The arm was pulled down by a winch or windlass and a lager stone placed at the end of the arm. The arm was then released and sprang forward to hit the frame to send the stone flying through the air.

4.4 The Trebuchet

The *trebuchet* was a monster sea saw, which could be classified as heavy artillery, and was a complicated version of the simple catapult and became popular in the twelfth century (Fig. 4.3(a) to Fig. 4.3(c)). A long, usually a trunk of a tree, with a sling at one end was pivoted and counterbalanced to a

heavy weight at the other. The arm was winched down and a stone weighing between two to three hundred weight in the sling. The arm was then released and the counterweight pulled the arm down, sending the missile on a high trajectory over or into the wall of a fort or castle. They hurled boulders 90 to 140 kg in weight over 550 meters, and also threw large metal balls, spears, arrow and so on.

4.5 Early Fire Weapons (I)

Kautilya[61] (c. 300 B.C.), one of the earliest writers on military tactics and weapons, systematically described every type of contemporaneous arms and armor. Pant[62], quoting the work of Kautilya, mentions weapons, such as *mahasara-yantra*, *bahumukha* (many faced), *parayanka*, *sarvato-bhadra*, *jamadaagneya* and so on. Kautilya also mentioned many methods to assault enemy fortifications. He said "With the help of artificial stair case (obviously scaling ladders) attempt should be made to reach the parapet wall, and if strongly protected machines, explosives and other material should be used to bring down the wall."

From the *Arthashastra* it is evident that forts were considered as highly defended localities and it gives detailed instructions for the ideal layouts, defense and methods of assaulting and destroying enemy forts. In this work, Kautilya speaks of arrows spiting fire and used for setting fire to enemy defenses and buildings. However, as no detailed descriptions of the weapons mentioned above are given in the *Arthashastra* it can only be presumed that the weapons mentioned are large fire weapons meant for destroying enemy forts, and incidentally to defend fortifications from enemy assaults, that is mechanically operated siege craft where some of them discharge incendiary missiles. Kautilya does not mention either gunpowder or firearms (*nalastra*). It is unlikely that this unusual man who was well versed on strategies of warfare and application of various types of weapon could have failed to mention firearms if they existed in his time. Another contemporary of Kautilya, Megasthenes and the Greek ambassador at the court of Chandragupta (c. 300 B.C.), does not mention the usage of firearms in his

accounts about India in the Maurya period. However, Pant[63] states that the weapons mentioned by Kautilya in his *Arthashastra* are probably missiles rather than firearms.

The much quoted Sanskrit work *Sukraniti*[64], believed to be written by Shukracharya, and assigned by scholars to the Gupta Period (c. fifth and sixth centuries A.D.), is another important work about weapons of the period. It prescribes guns and projectile weapons as the standard equipment for king's chariot. It also mentions a weapon *nalastra*, literally a tube weapon, which is believed to be firearms.

Once again, man applied his inventiveness to discover that some inflammable substances known to him when combined with appropriate (correct or suitable or oxidizing) agents resulted in highly combustible compounds. When such powders were enclosed within suitable containers and ignited, they burned rapidly generating heat and powder gases. When these gases within the container built up, high pressures resulted in an explosion that shattered the container. The explosion produced a loud report or noise, a bright flash of flames and clouds of smoke. Actually, man had invented explosive mixtures.

The earliest use of explosive properties of such combustible mixtures appears to have been in pyrotechnics or fireworks. The simplest and most common of these is a fire cracker. It mainly consisted of a small paper closed at one end with a plug, filled with an explosive powder and sealed at the other end. A wick or fuse burned slowly and ignited the powder in the tube resulting in a loud explosion.

Quite naturally, man soon realized the potential of the noise, flash and smoke produced by the fire cracker as an instrument to frighten the enemy or cause panic to his mount on the battlefield. The simple fire cracker was improved upon by replacing the paper tube with hollow pieces of bamboo and then by reinforcing the bamboo with lighter material like Rattan, Sinew, etc. The explosive mixture itself was continuously improved and the stronger

container devised made it possible to load them with larger quantities of it and it was possible to produce louder reports and more dazzling flashes of light.

It was soon discovered that when the container was modified suitably, the hot gases generated by an exploding mixture could be expelled from the container in a regulated manner, which according to Newton's law moved the container itself in the opposite direction. The simplest pyrotechnic instrument neutralizing the disc development was the primitive rocket. Both the pyrotechnics were gradually improved upon and ultimately developed into weapons, half-ways between fireworks and firearms. As, at present, there is no generally accepted nomenclature under which such military pyrotechnics could be classified, they may be called pyrotechnic or fire weapons.

Various types of fire weapons are mentioned in some sources of the medieval period. They had comparatively weak explosive powder, they were generally not made of metals, they were mainly used for generating noise, flash and smoke, and lastly, unlike the modern weapons they did not penetrate the target.

Thunderous weapons belching fire and smoke are mentioned in many accounts of medieval battles. But unfortunately, such accounts do not give us the constructional or functional aspects of these fire weapons. However, these descriptions led some early scholars and translators to believe that they are reading about firearms, by now familiar to them, Blackmore[1].

Farista tells us about this batter (1008), cannons (Top) and a musket (Tufang) were used by Mahmud (see, the History of India, ed. from Sir H.M. Elliot's papers by Prof. J. Dawson, Vol-IV, pp. 219 & 454).

4.6 Fire Weapons: Early Medieval Period

The other two military operations are as follows: first, in the reign of Jalal-ud-din Khilji (290–295) when he sent his nephew Alla-ud-din to attack Devagiri (now Daulatabad) where he defeated Ramachandra Deva. Second,

in the reign of Alla-ud-din Khilji (1296–1310) when he attacked Ramachandra and then proceeded to attack the Chittor fort, in quest of the famous beauty queen Padmini.

Pant[65] writes that according to Akram Makhome[66], *khusk anjeer*, meaning dry figs, during the time of Iltutmish there was a machine throwing stones. Poet Anwari also mentions it was a weapon used for siege, and according to *Bahar-i-Azam* it was an instrument that worked with gunpowder. This fact is corroborated by another manuscript, Adaa-ul-Harab, Shajaat Fakhr-i-Mulabir (A.M. Journal op. cit.). The *manjaniq* was a siege craft, which hurled at enemy forts, with great force, large pieces of stones, bottles, etc. *Sang-i-maghrabi*, also known as *midfa and manjaniq*, is mentioned by Zia-ud-din Barni[67] and Farista[68] also calls it *manjinique* and Maulana Abu Zafar[69] distinguishes it as Hindustani top. A paper published in an Urdu monthly magazine Haarif of December 1949, reads:

"sang-i-maghrabi was invented in the sixth century Hijri (c. twelfth century A.D.) and end of the Seventh century Hijri and beginning of the eighth century Hijri it was popular in Spain and Africa, and these countries were called *maghrabi,* meaning western, by the Arabs, and hence the name. However, this type of siege craft were called *midfa* in Arabic."

4.7 Fire Weapons: Late Medieval Period-1300 to 1700 A.D.

Indian chronicles, which are sources of the late medieval period are more abundant with reliable information about weapons in general, compared to the earlier period. The standard of education was rising and spreading rapidly, not only among the Brahmins but also among laymen. The Mughal royalty and nobility were invariably good scholars and keen sportsman, unlike the Brahmins. The chronicles of this period naturally contain more detailed descriptions of weapons and their applications on the battlefields and sports fields. It is, therefore, not very surprising that the best available references about fire weapons and firearms could be found from these

accounts' chronicles. Perhaps, such frequent references led some early scholars to believe that these weapons were introduced by the Mughals. However, ambiguity in the meaning of the words used for pyrotechnic, or fire weapons; proto-firearms and true firearm continue to bother scholars examining sources of this period. All these types of weapons were used throughout this period and anachronisms are very common that complicates the issues further.

4.8 The *Baan*

The *baan*, a primitive rocket, was perhaps one of the earliest fireworks that were modified successfully as a pyrotechnic for military purposes. As in the case of *naft* arrows *baan*s were also of two types: one exploded with a loud report while the other burst into flames and set fire to the target.

The simplest version of the *baan* consisted of a bamboo tube, about 30 cm long and 8 cm in diameters. It was filled with an inflammable powder, proto-gunpowder along with a fuse to ignite the powder, and was then closed at both ends with mud or wooden plugs. This tube was attached to one end of a bamboo staff. To launch this missile, the fuse was set alight and the missile was cast by hand, as a javelin, into the enemy ranks where the charge exploded with a loud report. The effective range and accuracy of such a handcast *baan* depended mainly on the physical ability and skill of the *baan*-thrower. To increase its effectiveness, it was subsequently modified to be launched by means of a bow or a catapult.

Another version of the *baan*, mentioned by Rahamn[70], works on the actual rocket principle. A special progressively combustible charge was loaded in the tube, by now of metal, and was ignited to produce a stream of powder gases and flames through the rear end of the tube (here only the forward end of the tube was closed) and this propelled the entire missile forward. Great skill was needed to launch this type of *baan* as there was always the possibility of its straying away from its course and landing among own troops. Moor[71], quoting from Major Dirom's Glossary, writing about

the siege of Dharwar (1794 A.D.) states: "Rocket: a missile weapon consisting of an iron tube about a foot long and an inch in diameter, fixed to a bamboo rod ten to fifteen feet long. The tube being filled with composition (note, not with gunpowder) is set fire to, and being directed by hand, files like and arrow to a distance of about a thousand yards, Some of the rockets have a chamber and burst like a shell; others called ground rockets have a serpentine motion and striking the ground rise again and bound along till their force be spent. The rocket makes a great noise and exceedingly annoy the native cavalry in India, who move in great bodies; but are easily avoided, or seldom takes effect, among own troops, who are formed in lines of great extent and no great depth." Bernier[72] also refers to *baan*s and states that they were used in battles between Dara Shikoh and Aurangzeb in 1653 A.D., for frightening horses.

4.9 The Charka, Charky, or Chakra

The *charky* was originally used in India as a firework but it was modified later as a fire weapon and Kalidasa[73] mentions it as early as the sixth century A.D. This weapon is often mistaken by some early historians and chroniclers for a type of rotating wheel, resembling the *Sudarshan Chakra*, a weapon of the Hindu deity, Lord Vishnu. The actual weapon consisted of a long wooden or bamboo staff with a cross-piece pivoted at one end. Two containers filled with a suitable progressively burning powder were fitted to the cross-piece, one at each end. When these charges are set alight the powder flared and discharged hot gases and flames through the apertures in the containers. These apertures were set in such a manner that the forward force generated by the escaping gases rotated the cross-piece rapidly, and two rings of swirling flames formed at the end of the staff.

The charka was an ideal weapon for frightening the elephant of the enemy forces as these animals dreaded fire. For this reason, the elephants have been used with very little advantage in warfare since the introduction of fire weapons.

4.10 The Gaj-Kundi or Dhamakha

The *gaj-kundi*, also known as *dhamakha*, in central India is yet another instance where a firework was modified for use as a fire weapon. It mainly consisted of a *kundi* (mortar), a small but strong iron cup with a deep cavity in the center, and a *gaj* (pestle), an iron pin about three to four inches long and about half an inch thick. This pin could fit securely into the cavity in the *kundi*. These two components are attached to a piece of string or wire, one at each end. A pinch of explosive powder, normally a mixture of sulfur and muriate of potash, was dropped into the cavity of the *kundi*, and the *gaj* was fitted securely into the cavity so that the powder lies between these two components. The firer held it by the string, or wire, and struck the head of the *gaj* against any hard surface, such as a large rock or a stone wall, when the powder exploded and produced a loud report. Such *gaj-kundies* or *dhamakas* are used in India till today to scare away birds feeding on crops and fruit trees.

Another typically Indian pyrotechnic weapon – a proto-mortar – consisted of an iron tube – the barrel – about eighteen inches long and two inches in diameter. The bottom end of this tube was closed, and a narrow vent was drilled close to it. Its projectile consisted of a charge of explosive mixture placed over another charge of progressively burning and highly inflammable powder which acted as a slow fuse. Both these charges were wrapped tightly with a piece of strong twine to form a squat cylinder.

To load this weapon, a charge of explosive powder – proto-gunpowder – was poured down the barrel followed by the missile described earlier. The powder charge in the barrel was then ignited at the vent and the resulting explosion ejected the projectile out of the tube, and at the same time set alight the charge of progressively burning powder at the base of the missile[74]. (Fig. 4.9(a))

The Espingnolle – Please see under European Fire Weapons

This was a European fire weapon based on the Roman candle principle – that is, it used superposed loads. The barrel, invariably an iron tube, was loaded alternately with charges of power and ball. Each bullet had a longitudinal channel, normally a hole drilled right through it to permit the flash produced by the burning charge powder above it. Once the first charge had been fired, the rest of the charged went off one after the other until the barrel was empty. Porta[75], described another version of fire weapon, a great brass-gun also working on the Roman candle principle. "First put in a certain measure of gunpowder, that being put in, may discharge the ball, but a small one, that it may go in loosely, and the powder put un upon it may come to touch the gunpowder; then pour in the dark powder[76] two or three fingers depth; then put in your gunpowder, and your bullet; and thus in order, one after the other, until the gun seems to be full to the very mouth."

The *gaj-kundi*, also known as *dhamaka* in central India, is yet another instance where a firework was modified for me as a fire weapon. The natural trends of development of fire weapons were twofold: first, to produce stronger explosive powders which could propel missile on explosive and penetrate targets; and second, to make the projectors of such missiles with metals. Perhaps, the only stage that differentiated these weapons from true firearms was the development of true gunpowder and its use as a propellant. In the absence of any other nomenclature for such forerunners of true firearms they can be termed proto-firearms.

It is generally believed that the Chinese were using proto-firearms by the twelfth century and they obtained the knowledge about these weapons from them and transmitted it to Europe. However, it is rather surprising that the Indian who had established close contacts with the Chinese much earlier failed to mention about them before the Arabs. Hence, the probability that the Indians knew about proto-gunpowder and proto-firearms and this knowledge reached both China and Central Europe appears to be a more plausible. The hypothesis, however, needs a more detailed examination.

[55] Pant, G.N., op, cit., pp. 146 and 244. *Quoting from Raghuvamsha XII*, 73.

[56] Kautilya. *Arthashastra*. Vachspathi Gairola, op. cit.

[57] Kalidasa. *Raghuvamsha XI*, 43.

[58] Blair, C. *European and American Arms c1100–1850*. BT Batsford Ltd., 1962, p. 35.

[59] Compton.

[60] Brent, P. *The Mongol Empire*. London, 1976.

[61] Kautilya. *Arthashastra*. Vachaspati Gairola, 1962.

[62] Pant, G.N., op. cit., p. 216.

[63] Pant, G.N., op. cit., p. 216.

[64] Vidyasagara, *J. Shukraniti. The Elements of Polity of Shukracharya*. Vol-I. Calcutta, 1902, pp. 95–103.

[65] Pant, G.N. op. cit., p. 244.

[66] Makhdomee, A. *Journal of India History*. Vol-XV, Pt. I, pp. 185–187.

[67] Zia-ud-din. Barni, Tarikh Firozshahi.

[68] Farista.

[69] Maulana Abu Zahar. Paper published in an Urdu monthly magazine. *Harif*, Dec-194-1949.

[70] Syed Sabahuddin Abdar Rahman, op. cit., p.49.

[71] Moor, E. *A Narrative of Captain Little's Detachment*. p. 509.

[72] Bernier, F. *Travel in the Mughal Empire*. London, 1891, pp. 74 and 157.

[73] Kalidasa. *Raghuvamsa, VII*, 46; quoted earlier by Pant, G.N., op. cit. p. 146.

[74] A painting (miniature) of a battle scene, Mughal, early sixteenth century in the collection of the National Museum, Delhi, reproduced earlier by Pant, G.N., op. cit., plate XV, opp. p. 112.

[75] Porta. *Natural Magick*. English edition of 1658, quoted earlier by Blackmore, op. cit.,p. 77.

[76] This was a rocket mixture composed of Turpentine-Rosin, liquid pitch, varnish, frankincense and camphor, equal parts, quick brimstone a third part and half; two parts of saltpeter refined; three A painting (miniature) of a battle scene, Mughal, early sixteenth century in the collection of the National Museum, Delhi, reproduced earlier by Pant, G.N., op. cit., plate XV, opp. p. 112.

Chapter 5
Projectile Weapons: Pyrotechnicor Fire Weapons

Some highly inflammable substances were used as incendiaries in warfare from ancient times. By the early medieval period, however, siege engines, such as large catapults, crossbows, hurling spears and iron bolts, and large slings hurling huge stones and metal balls, were used to destroy enemy fortifications. Some highly inflammable liquids, such as the Greek fire, were also sprayed through tubes and set alight to start extensive fires. Perhaps, later some inflammable substances were combined with other ingredients to produce explosive powders. They were known by various names in different countries, and in the same country at different periods. The earliest use of such explosive mixtures was in pyrotechnics, such as firecrackers, which was set alight by a fuse exploded with a loud report. Such noise makers were used in the early medieval period in warfare to frighten the enemy and to cause panic to his mount. As these weapons do not come under the category of firearms and no other generally accepted nomenclature is available now, they may be called pyrotechnic or fire weapons. Some typical examples of such weapons are the *Indian nalika, nalikastra, or nalastra (tube weapon); the Chinese p'ao; the midfa, and the Persian or Arabic sang-i-maghrabi and manjiniq*.

The pyrotechnic or fire weapons are proto-firearms, half-way between fireworks and true firearms. They are mentioned with increasing frequency in some early medieval period sources until they were gradually superseded by firearms. The characteristic features of fire weapons are as follows: first,

they use the explosive powders of a weak nature; second, they were normally not made out of metals, although some projectiles they discharged were made of metals; third, they were mainly smoke, flash and noise producers; and last, any projectiles they discharged did not penetrate targets as a modern bullet is expected to do.

Thunderous weapons including belching fire and smoke are mentioned occasionally in the accounts of some ancient battles. Although they are fire weapons, the scanty description given led some early scholars and translators to believe that they are reading about firearms. They also naturally presumed that the explosive charge used was gunpowder. Blackmore[77] very aptly remarks: "It is, therefore, not very surprising for them to have written the most convincing articles and books to prove to their own satisfaction, at least, that firearms were first invented in the country of whose records they were making a particular study. Both India and China have had the most ardent protagonists for this claim."

5.1 Projectile Weapons of the Past: Fire Missiles

The discovery of fire set humans apart. Who discovered it? When? How? These are questions for which the correct answers are not available. Ancient mythology tells us that it was stolen by man from the Gods. However, it provided early humanity with the much needed heat and light. Fire was used for more aggressive pursuits such as destruction of property and adversaries. The next natural step was to create weapons to project fire, or missiles, to reach farther than that which could be achieved by flinging them by hand.

It was discovered that some material caught fire and burned better than others, and a few burned so fiercely when set alight that it was difficult to extinguish them. Such combustible materials were used for incendiary purposes in warfare. The earliest material put to use were fat, tallow and vegetable oils, and they were used as incendiaries in warfare up to the mid-thirteenth century.

The *Nitiprakasika* (v 53 and 54) and *Mahabharata (Udyogaparva) Adhyaya*, 155, 527, tell us about boiling and the use of explosive oils. The resin of the sal tree (*Shorea robusta*) called *kalakala* is such a material, melted sugar (not treacle) and hot sand, pots filled with poisonous snakes, spikes and big stones, sauce and smoke balls (*dhumnagulika or churnagola*) bearing husks of corn and other such material are also needed for defending fortresses.

It was also better to utilize the already known projectile weapons such as bows and siege engines. Some ancient Sanskrit sources provide information on weapons known as *agneyastra* (five weapon), which was probably the type which discharged arrow, darts, or spears tipped with flax impregnated with oil, resin, sulfur, realgar, or bituminous substances, and set fire to before discharge. When *Nitiprakasika* was written, there were already machines that used fire. When *Sukraniti* was written, firearms had already been introduced.

Both the Mahabharata and Ramayana speak of the *agneyastra* (fire weapon), a wonderful weapon that plays an important role in warfare. Its description and capabilities are far beyond our conception of practicality. Don't we still read and enjoy the thrilling stories from Greek and Roman mythology? According to Mahrmi, the son of *Agni* received the *agnivasta* from Bharadwaja and he in turn handed it down to Drona, the son of Bharadwaja.

Harivansam, XIV, 33, Mahabharata Adiparva C XXX, 39, 40 and (Shakuntala, III, 56 and Utara Rama Chanto IV).

Harivansam

XIV 33

Agneyam astram labdhva ca

Bhartgavat Sagara nypah

Gigaya prthivim hitva

Talajarighan sahaihayan

Mahabharata Adiparva

C XXX, 39

Agnivesam mahabharagam bharadwajah pratapavan

Pratyapadayat agneyam asham ashavidain varah

Mahabharata Adiparva

C XXX, 40

Agnesta jatassa munistato Bharatasallana

Bharadwajam tad agnetan magasham pratapadayat

The *mahasara-yantra, bahumukha, jamadagneya* and others mentioned by Kautilya, in his *Arthashastra*, were also most probably siege engines discharging burning missiles to set fire to enemy installations.

Kautilya[78] said that "arrows spitting fire…" were used to destroy enemy fortifications and the Persians used *tir-i-atishin* (fire arrows) for setting fire to howdahs, tents and other paraphernalia that could catch fire.

One of the most effective and widely used incendiary materials of ancient times was *naphtha* or *naft*, as it was known in Persian and Arabic. It is a highly volatile and inflammable liquid, a constituent of asphalt and bitumen, found in natural beds. *Naphtha* vapor, like other gases of the same class, when combined with oxygen (atmospheric air) exploded with a loud report sufficient to alarm elephants and horses on battlefields. When the sound was accompanied by a blazing fire, as it generally does, it caused panic and terror.

Mir Khwand[79] relates how Alexander during his invasion of India used a large number of hollow images of iron and other metals in the form of soldiers filled with dry wood *naphtha*, to be set fire when the elephants of the Hindu forces advanced toward his army. In the early medieval period, contingents of *naft-andazan* (*naphtha* throwers) were trained especially for

offensive and defensive operations while assaulting fortified positions. As late as the First Crusade (1099 A.D.), bituminous fire shells or hollow brass balls containing fire, pitch and brimstone (sulfur) were used. In 1273 A.D., the Chinese made coverings for their horses with rice straw ropes covered with clay to protect the animals from the fire arrows of the tartars. Large scale use of *naphtha* missiles in siege operations by both the assaulting and defending forces necessitated the use of leather jackets and mantles soaked in vinegar and a covering of clay to provide protection against fire caused by such oil-based material. Siege engines and towers were protected by tiles covered with hides, or felt, soaked in vinegar, and covered with clay, for the same reason.

Oppert[80], who was a professor of Sanskrit and later the curator of the Government Manuscript Library, Madras, cites verses from an ancient Sanskrit work *Nitiprakasika* believed to be written by Vysampayana, which speaks of: "Smoke balls containing explosive material among weapon hurled against the enemy… The Indians not only knew from the earliest period the use of explosive powders for fireworks and for discharging projectiles but even made clay elephants that were exploded from a distance with a fuse to destroy an invasion force… Alexander as well as *Tamerlane*, had to face such devices in India."

Unfortunately, none of these early accounts describe properly either the functional aspects or constructional details of the so-called firearms. For instance, they do not mention specifically whether these weapons hurled incendiary or explosive projectiles by mechanical means (firearms) or expelled projectiles by an exploding charge of powder (proto-firearms).

The Sanskrit words *nalika (tube) and nalastra (tube weapon)* are believed to be guns by some protagonists of the Indian cause. Whereas the champions of the Chinese cause postulate that *p'ao, hua ch'iang and tuyan de feu* are guns. Unfortunately, such words can now be translated to mean that guns originally applied to incendiary, or explosive, or missile-hurling projectors, and it is not yet certain when these terms were applied

exclusively to firearms. For instance, the Arabic or Persian word *bunduc* (*H. bundook*) originally meant a fruit or nut of the cultivated hazel, then it meant a pellet of a stonebow and then a stonebow or crossbow, and finally a gun (a matchlock musket). If one would establish when this word *bunduc* was exclusively used to mean a gun, at least one step would have been taken in the right direction to establish the date, or at least the period, when guns were used in general by the Arabs or Persians.

The bow was undoubtedly the most popular projectile weapon since prehistoric times and generations of bowmen tried to increase its range and accuracy. Naturally, soon after the properties of explosive powders were known, both the soldier and sportsman explored the possibilities of utilizing gunpowder to hurl arrows. The possibilities of dispatching arrows with incendiary or explosive heads to cause loud reports or to start fires in the enemy concentrations were also experimented.

Bootes[81] (Fig. 5.1(a)) reproduced the arrow-shooting fire weapon taken from the Korean book. The Five Ceremonies was published in 1474, along with a photograph of a wooden arrow, about three meters long, tipped with iron and feathered. Blackmore[82] also reproduced a drawing of an arrow-firing midfa, from a reputed fourteenth-century Arabic manuscript mentioned earlier by Oscar Guttmann[83].

Before gunpowder was invented, the artillery commander hurled large rocks, heavy spears, bolts balls of metal, and quantities of incendiaries with mechanically operated projectors, such as large crossbows, slings and catapults. These siege engines were invariably heavy and cumbersome and were required to be assembled in situ by many workmen. But soon after the explosive properties of gunpowder were known, the artillery commander also started exploring the possibility of harnessing this force to launch missiles so that they could reach farther and hit with greater force. The new type of siege engines became more compact, could be assembled in armories well behind forward lines, and could also be moved along with the advancing columns of own troops.

The evidence now available shows that by 1259 A.D. the Chinese were using reinforced pieces of bamboo from which balls of clay, fragments of stone, and other solids were expelled by a charge of weak explosive powder – the prototype of a gun – half-way between a firecracker and a firearm.

5.2 Early Fire Weapons (II)

While examining early chronicles for references to fire weapons, a number of difficulties are encountered. First, to locate the extremely rare sources; second, to date them with reasonable certainty; third, to identify subsequent interpolations, if any, particularly in the case of later transcriptions and translations of nonexisting originals; and last to establish when certain words or terms mentioned in such chronicles, which could now be interpreted to mean firearms, meant when they were first recorded.

Many words, both from the Western and Eastern languages, which could now be translated to mean proto-firearms, denoted something else at the time they were initially recorded. For instance, the English word artillery was originally applied to contemporaneous weapons in general. The word artillery is mentioned in the Old Testament[84] and reads: "And Jonathan gave his lad, and said to him, Go, carry them to the city." The artillery consisted of bow and arrows that he was using to chase away David. The Latin or Greek word ballista and the English word artillery before the fourteenth century included all types of projectile-throwing weapons anterior to the use of gunpowder, missile-throwing projectors, such as the *arcubalista*, arbalest (large crossbow), trebuchet (large sling), mangonel (stone and bolt launchers) and so on. They were used widely in Eastern Europe to destroy enemy fortifications up to the fifteenth century. The Chinese word *p'ao*, for example, originally meant all types of ballistae, whereas, after firearms were introduced it was normally applied to cannons. Similarly, the Arabic or Persian word bunduc, originally meant a nut or fruit of the cultivated hazel (*Corylus ovellania*), then a pellet of a stone crossbow, then a crossbow and finally a matchlock musket. The Mamluk word *naft* was originally applied to incendiary material, such as *naphtha*, but later it also meant gunpowder and

then fire weapons. The Sanskrit word nalastra, literally a tube weapon, was applied to firearms only after the invention of gunpowder. Such ambiguities often cause confusion and uncertainty while ascertaining the actual meaning of certain words, used in early sources, which were now applied to firearms.

Unfortunately, it is a fact that early writers and the so-called chroniclers failed to separate myth from history and the few recordings on technical subjects are rather vague and confusing. There was also a tendency, particularly among expert craftsmen in the Eastern World, who were still sufficiently barbaric in spirit to keep the methods and results secret as far as possible. Perhaps they realized from the very beginning what enormous advantages their possible discoveries might give them to what far-reaching consequences they might have on human life.

For instance, the Chinese court official Ts'ai Lun brought to the notice of the Chinese Emperor Hoti in 105 A.D. that cheap writing material could be made from pulp of rags, tree and old fishing nets, and drying the thin layer of scum formed on the top. This valuable invention of paper was a closely guarded secret of the Chinese for well over five centuries. In 751 A.D., the Chinese made an attack upon the Arab Muslims in Samakand, they were repulsed and among the prisoners taken from them were some skilled paper makers from whom the art was learned. The manufacturer entered Christendom either through Greece or the capture of Moorish paper mills during the Christian reconquest of Spain.

Another example of this nature is the dissolution of the ancient Indian technique of tempering copper articles. This technique was known to a few Indian coppersmiths and it passed from one generation to the next. Unfortunately, many centuries ago there occurred a break in this chain of transmission of this knowledge and the technique was lost sight of. This is the attitude of mind, typical of the expert craftsmen, oriental races still prevalent.

The Roman candle was one of the early fire weapons mentioned in the European chronicles, although it is now commonly used as a firework. It consisted of a hollow tube of wood or bamboo (or iron), tightly wrapped around with hemp, hide, or wire, for strength. It was located from the muzzle with alternate layers of combustible powder and incendiary ball, usually of tallow, or sometimes a *naphtha*-soaked wad. It was ignited at the muzzle and as the fire worked round each ball it touched off the powder to launch the ball ahead. Obviously, such weapons were used mainly for incendiary purposes.

5.3 The Espingnolle

This was another fire weapon working on the Roman candle principle, that is, it used superimposed loads. The barrel, invariably an iron tube, was loaded alternately with charges of powder and ball. Each ball had a longitudinal channel, normally a hole drilled right through it, to permit the flash produced by the burning powder above it. Once it has been fired, the rest of the charges went off one after the other until the barrel was empty (Fig. 4.4(a)).

Blackmore[85] mentions a fire weapon working on the Roman candle principle, quoting Porta's[86] earlier work and instructions for loading it.

[77] Blackmore, H.L. *Guns and Rifles of the World*. London, 1965, p. 1.

[78] Kautilya. *Arthashastra*. Vachaspathis Gairola, 1962.

[79] Mir Khwand. *Rawdat as-Safs*.

[80] Oppert, G. *On the Weapons, Army Organization and Political Maxims of the Ancient Hindus*. With special reference to *Gunpowder and Firearms*. Madras and London, 1880.

[81] Bootes, J.L. *Korean Weapons and Armour*, tr. Korea Branch Royal, Asiatic Society, Seoul, Vol-XXIII, pt. 2., 1934. Blackmore, H.L., op. cit., p. 2.

[82] Blackmore, H.L., op. cit., p. 2.

[83] Guttmann, O. *Manumenta Pulueris Pyni*. 1906, fir. 70.

[84] *The Old Testament, I*. Samuel 20:40, King James Version, 1611.

[85] Blackmore, H.L. *Guns and Rifles of the World*. London, 1965, p. 77.

[86] Porta, N.M. English edition of 1658.

Chapter 6
Incendiary and Explosive Powders

Since man learnt about fire he has been devising ways and means of utilizing it to defend himself against adversaries. In his attempts to kindle it easily and to increase its intensity he gradually discovered many inflammable and incendiary substances and mixtures. Perhaps much later he was also able to mix some of them to produce explosive powders as well. Some inflammable substance and mixtures burned fiercely when set alight and were useful in warfare as incendiaries. Upto the mid-thirteenth century, a few inflammable substances such as fat and tallow were used as incendiary on battlefield.

Naphtha, light petroleum, was a highly inflammable and volatile liquid, a constituent of asphalt and bitumen, found in natural beds. Missiles soaked with *naphtha* and set alight were launched into advancing enemy columns to cause confusion among the ranks and panic their mounts. Such blazing missiles were also cast into enemy defended localities to start fire.

Kautilya[87], the great Indian scholar, tactician, writer on weapons and warfare, and the chief adviser to Emperor Chandragupta Maurya (c. 323-297 B.C.),recommended "arrows spitting fire" and "birds with their tails tied with inflammable material" to set fire to enemy building. Pant[88], quotes Kautilya to say that machines and explosives were used to bring down forts. India in305 B.C.

Magasthenese was a Greek ambassador of Seleukos after his invasion at the court of Chandragupta Maurya at Pataliputra for about five years (c. 300 B.C.).He left some records and wrote a book called Indica about the Maurya Government and India life. Pant[89] states that Magasthenese wrote about a

kind of oil known to the Indians, which was extracted from a worm found in the Indus River to ignite everything.

Oppert[90], a professor of Sanskrit and later the curator of the Government manuscript Library, Madras, cites a verse from an ancient Sanskrit work *Nitiprakasika*, believed to be written by Vysampayana in c. 800 B.C., which speaks of: "Smoke balls containing explosive material among weapons to be hurled against the enemy." Oppert was also of the opinion that "The Indians not only knew from the earliest period the use of explosive powders for fireworks and for discharging projectiles but even made clay elephants that were exploded from a distance with a fuse to destroy an invasion force."

6.1 The Greek Fire

The chronicles of both the eastern and western worlds show that highly inflammable mixtures were used as incendiaries in warfare from at least the sixth century A.D. The Byzantine Empire, for example, owed its successful defense from repeated attacks of the Arabs largely due to the knowledge of the so-called Greek fire, the composition of which was a closely guarded secret for many centuries. It was a viscous mixture originally based on the highly inflammable light petroleum (*naphtha*), and did not contain saltpeter as many recipes of the later period. The other basic ingredients of the original Greek fire were sulfur and quicklime. Its characteristic feature was that it burned fiercely over water also. It is generally believed that the Greek fire was invented by Gallinicus of Helipolis.

Heliopolis Justinium I (527–565) was an Emperor of Eastern Roman Empire, then known as the Byzantine Empire, and was an ambitious and energetic ruler. His empire was at the peak of its power and glory a period when Western Europe came nearest to utter chaos. Constantinople was the capital of the Byzantine Empire and was known as Byzantium. It was built on the shores of Bosphorous and was the most important city in the empire. It was the aim of every invasion force to capture this important sea port before attempting the conquest of the rest of the empire. The invincibility of

Byzantium was mainly due to the powerful navy of Justinium. The ships were equipped with tubes through which Greek fire was sprayed over the surface of the sea and set alight. It not only prevented enemy ships from entering the harbor, or even approaching the coast, during an invasion, but also destroyed any ship afloat near the fire.

The Cambridge Medieval History[91] records the long and glorious innings of the Greek fire, lasting well over four centuries:

"Justinian's victory in 532 destroyed the Vandal sea-power, and Byzantian shipping was unmolested for nearly a century. The trouble period that followed the death of Haraclius coincided with the rise of a Muslim navy, operating from the Syrian ports, which cut the Mediterranean routes, already infested with Slav pirates in the Adriatic. More dangerous still was the seaward advance of the Arabs toward the capital (Byzantium), beginning with the capture of Rhodes and Cyprus, and culminating in the five-year blockade of Constantinople by Byzantium (674–678 A.D.). The repulse, with the aid of the famous 'Greek fire,' of the formidable thrust marks the turning point in the Byzantine naval history."

6.2 The Chronicles Continue

"Determined to cut out the heart of the empire, Naslmana, the brother of the Umayyad Caliph Sulayaman (715–17) crossed the straits from Abydus and began to lay siege to Constantinople on August 15, 717 (or possibly a month earlier), after having assembled vast stores, an army of 180,000 men, and a large armada of more than 2,500 ships. But the Imperial defenses were in excellent shape, since the Arab attack has been anticipated from the time of Anastasias II. Moreover Leo III (Byzantine Emperor 717–41) conducted a brilliant campaign behind the impregnable ramparts of the city and under the protection of the Byzantine navy, then at the peak of efficiency with the deadly 'Greek Fire,' the prototype of modern gunpowder. Byzantine fleet prevented the enemy from making effective use of the seaways, and the infantry routed the Muslim under Mardasan in Bythynia, on 15 August 718,

after the lapse of exactly a year. Maslama was ordered to return by the Caliph Umar II, who had succeeded Salayaman in 717. Arab sources report that 150,000 of the attackers perished in the course of the campaign. In breaking the blockade of Constantinople, Leo saved the empire from destruction and inflicted upon the Arabs so overwhelming a defeat that they were never again able to threaten the capital."

6.3 The Chronicles Conclude

"Krum, the new and aggressive Bulgar Khan, demanded confirmation of a treaty that had been probably concluded between Constantine V and the Bulgar Khan Kormisov and threatened that if the Byzantines did not meet his terms he would make an assault on Mesembria. While the Byzantine peace treaty, led by the Patriarch Nicephorus and the higher clergy, argued against the partisans of war headed by Theodore the Studite and his monks, who were unwilling, on scriptural ground, to hand back deserters as the treaty required, Krum took Mesembria (5 November 812) along with vast treasures, including great stores of gold and silver, thirty-six bronze tubes for the discharge of Greek fire, the chief weapon in the Byzantine armoury, whose composition was a closely guarded secret, and a great supply of the vital substance itself."

This narrative proves conclusively that the recipe Greek fire was kept a closely guarded secret until about 812 A.D. And the Bulgars were the first to learn about it in the same year. Deguignes (M. Deguignes, Historia Generale des Huns, II, page 61) under the year 917 says that the Khilans carried with them a combustible, which they had received from the King Oui, and that this fluid burnt even under water – obviously Greek fire. It appears that the composition of Greek fire was modified after saltpeter was included in combustible or explosive mixtures, such as gunpowder.

This naturally resulted in the appearance of very powerful fortresses by the end of the late medieval period (1400) and the siege weapons and craft became less successful in demolishing them. The siege weapon and siege

machinery propelling their missiles by means of torsion, tension or counterforce reached their limits of development and capacity. Hence, the greater reliance on defensive strategies than offensives. By the mid-fourteenth century, the futility of using mechanically operated siege engines and the now redundant siege craft became increasingly obvious and the artillery commanders were keen to develop more powerful but at the same time less cumbersome than the bulky siege engines available.

It was also aimed to make the siege engines mobile so that they could be used both for offensive and defensive roles in the field, as well as for defense or assault of fortified positions. The timely invention of gunpowder made this dream come true. Nathaniel Brassiy Halhed's[92] translation of *A Code of Gentoo Laws*, or *Ordinances of Pundits* contains the following passage in the preface.

(See *A Code of Gentoo Laws*, a Ordinances of the Pundits, from a Persian translation made from the original, written in the Sanskrit language (by Nathaniel Brassiy Halhed) London, 1770, PP. L II, L III, and 53). The similarity of the second page quoted above (page 53, *A Code of Gentoo Laws*) to uv. 90–93 of the Seventh Book of Manu (*Manuvadhavasastra*), and Law Code states that the King shall not make war with deceptive machines or with poisoned weapons or with cannons or guns. "No one should strike in a combat his enemy with concealed weapons, nor with barbed arrows, nor with poisoned arrows, nor with Darts Kindle by fire."

Na kirthir ayudhir hanayt yudhyamanothane nipun

Na karnibir napi digdhair nagnijvalitejanaih

When we refer to *Sukraniti* vv 277 – "A King shall bear in mind the six principal of policy and the design of the enemy and his own, it always kill the enemy by fair or unfair fighting – 279, the soldier kills his enemy with a gun." This passage is just the opposite of what *Manu Laws Code* and *Gentoo Code* dictates and it therefore indicates that this policy was revised by Shukra after the invention of fire weapons.

The *Nitiprakasika* (v.44) agrees entirely with Manu, VII, 89. However, later during the first half of the 45th Sloka is also the same as Manu VII 90 but the later halves read: "No one shall strike the enemy with concealed weapon or with poisoned arrows, or with machines kindled by fire (Agnyutivalainyantrai)."

By the time *Nitiprakasika* was written obviously, the days of "Darts kindle by fire" were replaced by "Machines kindle by fire" by the time *Sukraniti* was written firearms seem to have been introduced.

Rahman[6] mentions that Unani-aag, literally Greek fire, was a viscous liquid made by many recipes. One contained gum of pine (samovar) and sulfur, another saltpeter and sulfur; and yet another saltpeter, salt, charcoal of cane, frankincense, camphor and wool from Habsa (Persia). As true Greek fire did not contain saltpeter, the first recipe must be the oldest and the others developed after saltpeter were known.

[87] Kautilya. *Arthasastra*. Vachaspati Gairola, 1962 and also ed. And tr. by Shama Shastri 1951.

[88] Pant, G.N. *Studies in Indian Weapons and Warfare*. Delhi, 1970, p. 241. Oppert, G. on the weapons. *Army Organizations and Political Maxims of The Ancient Hindus*. With special reference to *Gunpowder and Firearms*. Madras and London, 1880.

[89] Pant, G.N. Studies in Indian Weapons and Warfare. Delhi, 1970, p. 241.

[90] Oppert, G. on the weapons. *Army Organizations and Political Maxims of The Ancient Hindus*. With special reference to *Gunpowder and Firearms*. Madras and London, 1880.

[91] *The Cambridge Medieval History*. Vol-IV, *The Byzantine Empire* (Pt.I), *Byzantine and its Neighbours*. London, pp. 25, 63, 97–98 and 501.

[92] Halhed, N.B. *A Code of Gentoo Laws, or Ordinances of Pundits*. From a Persian Translation, made from the original written in Sanskrit language, London, 1770.

Chapter 7
The Sanskrit Chronicles/The Indian Chronicles

Strictly speaking, as often been pointed out, there is no such thing as the history of the ancient Hindus. Evidently, they have left us no trustworthy historical records of the past and the possibility of discovering fresh evidence of value is indeed doubtful. We are not better informed about the history of ancient times. A legend or a tradition might provide a vague clue, but the rest is all broken and fragmentary, unsatisfactory, as a puzzle where half the pieces are lost. However, some scholars, like Keith[93], do admit that the ancient Hindus did have some historical sense.

The earliest Sanskrit literature, like the great Hindu epics, *The Mahabharata, Ramayana and Harivamsa*, was a good source of historical information. Although they are basically mythological works, an occasional term, verse, or passage throws some light on matters of historical value. However, they cannot be depended upon for accuracy and chronology.

From about fourth century B.C., we are slightly better informed about events of historical importance. Accounts of Alexander's invasion and of the Mauryan Emperors, give us a fairly clear picture of the contemporaneous civilization with a military background. From about the second century B.C. to the third century A.D. there is a gap in the Indian history. There is better knowledge of history after the Chinese pilgrims start arriving. They tell us something about their experiences in India from about the third to sixth century A.D. Again after another gap of about two centuries, we learn about the Arab influence and their occupation of Sind and Multan in the eighth

century. From then onward, there are histories of different races who from time to time have invaded the country, for good or for evil. Some have swept over this land like a flight of locusts, blighting, wasting and destroying, but leaving no other trace to recollect their presence.

Because of the lack of adequate historical records of the past, it is extremely difficult to ascertain correctly the chronological sequence of historical events, which is so very essential to study and understand the contemporary developments in the field of literature, arts and sciences. History of weapons must necessarily reflect the history of warfare, and so both military and arms historians seek authentic sources of historical importance. The necessity, therefore, arises to establish the authenticity of every relevant source before admitting their contents as credible.

In order to establish the authenticity of any literary source, such as a manuscript or treatise, it is essential to ascertain the identity of its originator and the period of the treatise. If the source could be dated precisely it would be better, and if it could be proved that it is free of interpolations it becomes a source of unimpeachable authenticity.

The identities of authors of many early Sanskrit works are normally shrouded in mystery or obscurity. It is a fact that all such works were originally conceived and committed to memory and then recited as occasions demanded. Perhaps, this was one of the reasons for composing them in verse rather than prose. At some later dates, they were written down, possibly by more than one writer, and by this time the actual authors were forgotten. Rightly, these writers did not claim the authorship for obvious reasons. Many deities, ancient sages, or legendary kings were assigned to these works. Their ancestry was traced to a God of Demi-God. This possibly followed the typical oriental practice of assigning deities in mythological works. A special age – the *Satya Maha Yuga* – where Gods fraternized with mortals on earth is mentioned in these works. It is, however, not clear whether this is a mere myth or a fact. Incidentally, the four Yugas, or ages, are not mentioned in the ancient Vedic literature. The

concept of the *Maha Yuga* could have been thought of at a later period. To assign Divine origins to many things was the norm of these works. Some ancient Chinese treatises also follow similar style of writing.

The Mahabharata, for instance, is believed to be dictated by a Hindu sage Veda Vyasa and written down by Lord Ganesh, the son of Lord Siva, the destroyer. The *Dandaniti*, an ancient Sanskrit work on civil and military administration, was written by Lord Brahma, the creator of the Universe. The *Dhanurveda* is another classic example of works assigned to divine sources. Originally, even Gods were unaware of the percepts of the *Dhanurveda* and this led to their utter defeat at the hands of the *asuras* (demons). Eventually, Gods were instructed in the mysteries of the *Dhanurveda* and then they regained supremacy. Lord Brahma Deva is said to have communicated this Veda to king Prthu, the son of Vena.

It was also a common practice among early writers to compile treatises based on earlier works, or to extract certain portions of a larger works, and enlarge it into a separate work. For instance, the *Dandaniti* by Brahma Deva was abridged into *Vaisalaksa*, *Bahudandaka, Brhaspatya and Nitisara*, by Lord Siva, Lords Indra, Brhaspathi and Usanas *(Shukra)*, respectively. Similarly, the *Sukraniti* is probably an extract of the larger work *Nitisara*, Usanas' *version of the Dandaniti and the Nitiprakasika is an extract of another larger work devoted to Nitisastra*.

Yet another peculiarity of some ancient Sanskrit writers was that they were known by more than one name. For instance, it is believed that Shukracharya, to whom the *Sukraniti* is assigned, was also known as Usanas (Usana), Maghabhava, Kavi, Kavya, Bhargava, Sadasarichis, Dhaityaguru and Dhisnya. According to *The Mahabharata*, Usanas (Kavya) followed Brhasapathy, and references are also made to Manu, Bhardwaja and Gauresiras. According to the *Nitiprakasika, Shukra* comes after Brhaspathy, Manu, Brhaspathy, Sukra and Bhardwaja.

Another characteristic feature of some ancient Sanskrit works is the uncertainty of numerical figures mentioned to specify quantities. For instance, Brahma Deva's *Dandaniti* is said to contain enormous number of 100,000 chapters, and according to the *Sukraniti* the strength of the largest army unit, the *Aksauhini*, is 2,187,000,000 – both figures are obviously overexaggerated. It is doubtful whether the numeral *shunya* (zero) was known at the period when these works were complied. Most probably, they had only nine numerals, and they used the term *dasa, sata, sahasra*, and so on for tens, hundreds, thousands, respectively. Hence, by inadvertently using the wrong term the value of a number increased or decreased many folds. Such mistakes probably occurred when these works were first written down. It is also quite likely that sometimes wrong terms were included to suit the rhyme or rhythm of a verse. There is also the possibility that such exaggerations were deliberately introduced to stress the importance of a particular verse or passage.

Dating Sanskrit works is mostly difficult, mainly due to the nonavailability of originals. The copies available now are subsequent transcriptions of uncertain periods and their edited versions and translations were published much later. Translated versions cannot be completely depended upon for accuracy as wrong technical terms are often used. Pinpointing interpolations is also difficult, again due to nonavailability of the originals to compare. As discussed earlier, uncertainty of the names and periods of originators and lack of historical records to establish a reasonably correct chronological sequence of historical events make the task of dating Sanskrit works more difficult. It has been correctly said that if all the reports were true and all translations correct, the drudgery and anxiety of historians would be considerably reduced.

Almost all Sanskrit scholars belonged to a small religious community of *Brahmanas* who occupied the highest place in society on account of their virtues, spirituality and asceticism. They were the teachers, priest, judges, assessors and ministers recording more aspects of contemporaneous

civilization, since very few outside the religious circles could read or write. Even the kings of the bygone eras were mostly illiterate. *The Mahabharata*, *Harivamsa*, *Dandaniti*, *Dhanurveda* and *Nitisara* were only recited to kings by the learned Brahmanas. The large majority of India's populace depended upon the Brahman pundits for interpreting Sanskrit works. And to hold the attention and interest of audiences, these learned men often resorted to exaggerations, introduction of unrelated topics, and interpolations of material often created by their own fertile imagination.

An average Hindu has always been morbidly fond of supernatural powers, wonders, miracles and spells. He is also fond of connecting everything, even the most material substance, with some metaphysical cause, we must not be surprised, therefore, if writers of ancient times catered for such idiosyncrasies.

Most ancient Sanskrit works belong to an era when history, myth, science and philosophy were not separated. They are mainly myths, legends and fantasies. Nevertheless, scholars cannot afford to discard evidence, however slender, merely because it is enmeshed in a labyrinth of apparently superfluous matter. Some grains of significant truth may be found in them if one seeks with a critical mind.

Fortunately, some Sanskrit works on polity (*niti*) and duty (*dharma*), and manuals of law, weapons and administration, do provide fairly reliable information, provided the appropriate or relevant verses or passages are interpreted and understood correctly. From such works, we learn that Hindu warfare was conducted according to elaborate maxims laid down in manuals. It was ritualistic and supported values such as chivalry, generosity and compassion toward the vanquished foe, consideration for the old, disabled, young and weaker sexes belonging to the defeated armies. Contempt for those who violated these rules was characteristic of Hindu warfare.

The origin of firearms is obscure. The Chinese knew about proto-gunpowder by about eleventh century A.D. and about proto-firearms by about mid-thirteenth century. By the fourteenth century, the Arabs had passed this knowledge to the West.

No consensus has been reached on the question of whether or not the ancient Hindus knew about firearms. However, it is generally agreed that there is a probability that they knew about military pyrotechnics, such as fire arrows, flame throwers by about the fourth century, and about gunpowder weapons before the thirteenth century. Nevertheless, modern arms historians are of the opinion that too little research has been done on Indian sources to prove conclusively that firearms were known to the Hindus before others. They are also of the view that the little work which has been done was mostly by scholars not sufficiently conversant with the basic technical and functional aspects of firearms, which is so essential for such work.

While considering the relevant Sanskrit sources for references to firearms, the first step would be to identity words or terms that apparently signify them and then to differentiate the words signifying weapons hurling incendiary or explosive material (fire weapons) from those which mean weapons worked by explosives (firearms). Unfortunately, it is not so simple as it sounds for it is extremely difficult to ascertain what exactly certain words or terms, which could now be translated to mean fire weapons or firearms, meant when they were originally recorded. There is also the difficulty to ascertain exactly when certain words or terms applied to military pyrotechnics, fire weapons and proto-firearms ceased to mean and were specifically applied to true firearms.

For instance, the Sanskrit word *nalika*, originally meant a tube, such as a piece of hollow bamboo or reed. When pyrotechnics were developed, all those that utilized such tubes were also called *nalika*, and when these were modified as military pyrotechnics, the same name was continued to be applied to them. Later, when proto-firearms were introduced, missiles were continued to be propelled from tubes and, therefore, the term *nalika* was

applied to them also. Ultimately, when firearms were developed with a barrel as the main component they were also called *nalika*. Therefore, it may be correct to say that the word *nalika* was a generic term for fire weapons, including firearms in which a tube formed the major component. By about the time the *Sukraniti* was written, the term *nalika* was invariably prefixed with other qualifying terms such as *laghu, brhan, ksudra and brhat*. Gradually, the term *nalika* came to disuse and was replaced by other firearm terminology by the end of the eighteenth century. Now the question is when was the word *nalika* applied exclusively to mean firearms?

The literary sources relevant to this investigation are *The Mahabharata, Harivamsa, Arthashastra* and *Kamandakiya* (a work containing all the science and acknowledged as one of the earliest works no Nitisastra). Also, other sources include *Manusmriti* (the law book of Manu), *Agnipurana Krisna-Yajurveda*, *Dhanurveda*, *Nitiprakasika* and *Sukraniti*.

7.1 The Mahabharata

Long ago, a great battle was fought near Tanesar, between two rival clans, the Kauravas and Pandavas. *The Mahabharata*, the story of this battle, belongs to ages when myth and history had not been separated and Gods came down from heaven and fraternized with mortals. Containing 18 books, 100,000 *slokas* (couplets) of nearly 220,000 lines, *The Mahabharata* tells about the deadly feud between the five Pandavas, sons of Pandu, and their cousins, the hundred Kauravas, the sons of the blind king Dhritarashtra.

Dhritarashtra divided his kingdom between his sons and nephews, giving the city of Hastinapur (about 80 km. northeast of Delhi) to the Kauravas, and the city of Indraprasta (about 3 km out of the Delhi Gate) to the Pandavas. However, the Kauravas became increasingly jealous of the popularity of the Pandavas. The final breakdown ensued when Yudhishtara, the eldest of Pandavas, was defeated fraudulently in a game of dice, which led to the degradation of Draupadi, the common wife of the Pandavas. The Pandavas were exiled and they had to spend 13 years in the jungles. They

went to Lord Krishna, a ruler of Yadavas and Virat, the King of Matsya. Lord Krishna tried to pursue Dhuruyodhana to give the Pandavas their due share of the kingdom but failed and so the incredible war ensued.

The army of each clan gathered its hosts and camped at Kurukshetra, the field of Kuru, near Tanesar. For 18 days they fought, each singling out his man and striving hand-to-hand, while arrows fell about them – sparkling like the rays of sun – and when sudden darkness covered the plain, they lighted torches and went on with their work. At last, all the combatants, on both sides, were killed excepting Dhritarashtra and the Pandavas, and the latter became the lord of the realm, and ascended the throne of Hastinapur and after sometime the Pandavas put Parikshit on the throne and returned to the Himalayas. *The Mahabharata* is the earliest epic of the Indo-Aryans and is normally connected with the white Yajurvedas and its Brahamana, the Satapha. No one could say when *The Mahabharata* was written, but it is generally believed that it was dictated by the illiterate sage Veda Vyasa and recorded by Lord Ganesh, the son of Lord Shankara or Siva in 400 B.C. and it took another 800 years to take its final form. However, *The Mahabharata* in its present form seems to have been known to Patanjal (second century B.C.) as per his work *Mahabhashya*. Being handed down orally from the earliest times it is not hard to presume that it has undergone many changes, and it cannot claim any definitive text. Naturally, the original work of this immortal epic is not available, and we have today the subsequent transcriptions, edited versions and translations printed after thefifteenth century. Three different texts of *The Mahabharata* are extant,the northern or Kashmirian, the southern and the Javanese. In the southern text, thousands of verses, and materials drawn from the *Puranas* and the *Harivamsa*, sometimes by insertion of a section of new chapters. The Javanese text appears to contain the least interpolation. Dr. R.D. Banerji opines that *The Mahabharata* belongs to the later Vedic periods and Janamijay and Parikshit were real kings who belong to the Brahamian period.

Although the original *Mahabharata* was an epic, it later became a secret book of the Hindus, and so later some episodes were changed or even deleted and anachronistic interpolations were introduced, which ultimately merged with a main chronicles. The Bhargava family was mainly responsible for incorporating material on *dharma* and *niti* in *The Mahabharata*.

Numerous weapons are mentioned in *The Mahabharata*, and among them the most discussed one is the *agneyastra* (fire missile). According to *The Mahabharata*, Aurva, the son of Urva, gave the *agneyastra* to Sagara (ocean). There is also another legend in *The Mahabharata* to say that Agnivasa, the son of Agni (fire) received the *agneyastra* from Bharadwaja, and he in turn gave this weapon to Drona, the son of Bhardwaja (*Harivamsa* XIV, 33; *Uttara Rama Charita*, VI). However, the *agneyastra* was obviously an arrow, dart, or bolt impregnated with oil, resin, sulfur realgar, or bituminous substances, and set fire to before discharging it with a bow. Thus, we learn from *The Mahabharata* that fire arrows or fire darts were used by the people during the time it was written.

7.2 The Arthashastra

The *Arthashastra* is connected with the principles and laws of the *Artha*. It was probably during the Maurya period that one of the most significant documents of Indian history – and of the Hindu military history – was also written. This was the *Arthashastra*, a manual of polity and military maxims, which has been generally ascribed to Kautilya, alias Chanakya. Kautilya came from a poor Brahman family but due to his intellectual and administrative abilities he rose to become the most powerful personality of his times. He was a close friend and the principal adviser of Emperor Chandragupta Maurya (323–297 B.C.). He was also a great diplomat, scholar, military tactician and writer on military science.

The period of Kautilya, and significantly that of the *Arthashastra*, is a bitterly discussed issue of which no consensus has been reached. Some historians are of the view that the *Arthashastra* was compiled by an

unknown author, later than the Chandragupta's period. Kautilya refers to Salaksha, Indra, Brihaspati, Shukra, Manu and Bahardwaja. The *Manusmriti* is the next authoritative work on Hindu Law, which was adopted by the British in India. *Manusmriti* is also called *Manava Dharmasastra*. It is also believed that this work was of the Vedic schools of the black Yajurveda and it refers to *Dharmasastras of Atri, Gautam, Shaunaka and Vibhishta*. The *Manusmriti* is referred to by *Yajnavalkya* and Vishnu. Manu refers to Shakas, Kiralas, Dravidas, Yavanas, Kambojas, Pahlavas, Chinese, etc.

The founders of various schools on polity and law were Manu, Brahaspati, Sutra and Vsanas and the various works were ascribed to them and mostly lost. Some military historians subscribe to the hypothesis that the *Arthashastra* was based on an earlier Chinese military treatise, assigned to a legendary Chinese general Sun Tzu who was a native of Chi (now Shantung) during the fifth century B.C. This treatise, known as the *Art of War*, is considered by western scholars as the first known military work. It reveals a profound understanding of the philosophy of military conflicts and is fundamental to military leadership. Sun Tzu's practical approach to problems of military administration in war as well as in peace is so sound that it is applicable even to the present day in the *Art of War*, and so is the possibility of such information being borrowed in one direction or the other. Many original Indian books particularly on Buddhism were taken by the Chinese travelers from India to China and were translated into Chinese. The original works have now been lost but many of their translations still remain. However, the *Arthashastra* not only gives clear pictures of the political. Social religious and military conditions of the Maurya period also reveals the ideas of both Kautilya and Chandragupta. The *Arthashastra* is often compared to tactics of Machiavelli, whose military philosophy was: "Although in all other affairs it is hateful to use fraud, in the operations of war it is praiseworthy and glorious." Both seem to agree toward religion and morality and advocated rules of grossly on unscrupulous nature on the plea of public interest and without the least pretense of moral disapproval.

Essentially, the *Arthashastra* is an exhaustive manual that sums up the early Hindu concepts of polity, government, law and administration in war and peace. It is mainly concerned with the practical problems of government and describes the machinery and their functions to deal with them. Perhaps the only other work on the subject that excels this in exhaustiveness is the *Sukraniti*. The sections of the *Arthashastra* dealing with military maxims elaborate about the composition of the army function of the various branches and services of the army, training and discipline of army personal, duties of officers, rules of field operations, siege craft, fortifications and military tactics and strategy. The *Arthashastra* also instructs about readiness, alertness and defenses of entrenched camps in military operations. The *Arthashastra* consists of 15 *Adhikarana* (sections) and 180 *Prakaranas* (subsections). It has about 6000 *slokas*. The books were discovered by Sharmashastri in 1909 and were translated by him into English. It is mainly concerned with the political problems of the government and describes its machinery and functions both in peace and war. According to Sharmashastri, Ganapatishastri, N.N. Law, V.A. Smith[94], Fleet and Jayaswal, Kautilaya's *Arthashastra* was written by the prime minister of Chandragupta Maurya alias Kautilya. However, according to Winternitz, Jolley, Keith and Dr. Bhandarkar the work is of much later ages and was written in the early centuries of the Christian era. The fact is that the *Arthashastra* does not mention the Mauryan Empire and its administrative machinery, and Megasthenes, a contemporary of Chandragupta, does not mention it either. According to Jolly[95], the *Arthashastra* was written in the third century A.D. The *Arthashastra* quotes a verse (Navamsharvam) from the *Yajnavankya of Basa* of third century A.D. Kautilya knew the *puranas* (Gupta period), *Vaisika* (one of the section of *Kamasastra*), *Ashtadhyayi* of Panini (second century A.D.), and so he concludes: "His work is the outcome of a long period of literary activity in the field of polity than a production of a creative genius – another reasons for not fixing its age limit to high."

The Greeks do not mention Kautilya. *Arthashastra* mentions alchemy, which is a later discovery. The description of India as given by Megasthenes and the inscriptions of Asoka are not so advanced as those given by Kautilya. Megasthenes says that the Indians did not know the art of writing, whereas Kautilya mentions written documents. The Magadh capital Patliputra is not mentioned by Kautilya and Kautilya shows that the book was written in the south. The fact that favors the hypothesis that Kautilya's work, the *Arthashastra*, was written in the fourth century B.C. is that Kautilya is mentioned in the *Panchantantra, Karamandaliya, Dandaniti* and other works. It is a fact Patanjali does not mention Kautilya, but he also failed to mention Asoka, Bindusara and Buddha. The verses he quotes from Bhasa might have been old in popular memorial verse well-known from ancient times. It is true that there is much in common between *Arthashastra* and *Yajnavalkya* but this does not prove that the former was not written much earlier. For instance, the word *yukta* (official) went out of use before the times of Asoka as his inscriptions use the word *yuta* instead and in the *yajnavalkya* the word *yogyva* is used. Thus, the belief that the *Yajnavalkya* nearly versified the laws of Kautilya appears to be true. Apart from the above consideration, there appears to be sufficient evidence to presume that Kautilya's *Arthashastra* was written in the fourth century B.C., says Mahajan[96].

7.3 The Kamandakiya

The *Kamandakiya* or *Nitisara* of *Kamandaka* was probably compiled in the Gupta period and it is a metrical summary of Kautilya's *Arthashastra* and so could be memorized without much difficulty.

7.4 The Manusmriti

The *Manusmriti* or *Smrities* of Manu or Manavadharmasastra is one of the many *Dharmasastras* which deal with laws of Dharma. According to Buhler[97], the *Manusmriti* was compiled between 200 B.C. and 200 A.D. The

other *Dharmasastras* by Vishnu, Yajnavalkya and Narada are in verse except the one by Vishnu, which is in prose.

The *Nitiprakasika* (expounder of polity) was unknown upto the last century. It was discovered and translated into English by the German scholar Gustav Oppert[98]. According to Oppert, the *Nitiprakasika* is an extract from a larger work devoted to *Nitisastra* and contains the most comprehensive version of the *Dhanurveda*. Although he does not assign any specific date to the *Nitiprakasika*, it is believed that it was compiled in the eighth century B.C.

Like many other Sanskrit works, the *Nitiprakasika* also begins with a legendary account of a fight between the Hindu *devatas* (deities) and *asuras* (demons) in which the former were utterly defeated due to their ignorance of the percepts of *Dhanurveda*. Lord Brahma then imparted this knowledge to the deities and they in turn defeated the *asuras* and regained their supremacy. Later, the secrets of the *Dhanurveda* were revealed by Lord Brahma to king Prthu. It is also mentioned in the *Nitiprakasika* that Vysampayana (a pupil of Veda Vyasa, the originator of *Mahabharata*) narrated the *Nitiprakasika* to king Janmejaya, the great grandson of *Arjuna* – the son of Pandu – at Taksashila in Punjab.

Oppert's version of the *Nitiprakasika* is based on two copies he obtained, one from Madras in Telugu script and the other from Mysore in Grantha characters. The former contained a complete commentary by Sitarama, son of Nanjunda, who was probably a native of Bellary District in the present Karnataka state. The rulers of the Vijayanagara Empire had established their capital at Hampi, about 10 km from Bellary town, and it became a famous center for literary and cultural activities of the period. The rulers of Vijayanagara Empire were great patrons of art and literature and at their court resided the most renounced Telugu and Sanskrit scholars of the day. Under their patronage a number of Sanskrit works were rewritten in Telugu script and some were also translated into the Telugu language. Quite probably the Telugu copy of *Nitiprakasika* was written in the prosperous

days of the Vijayanagara Empire (about the fifteenth century) and was based on an earlier Sanskrit version. It is also probable that this version of the *Nitiprakasika* is another version of the *Dhanurveda* of the fifteenth century or later.

The *Nitiprakasika* is divided into eight chapters or cantos. The first chapter describes the manner in which Lord Brahma taught king Prthu the *Dhanurveda*. Then second chapter starts with the actual *Dhanurveda*, in which weapons and missiles were grouped under four classifications. The third chapter is devoted exclusively to the sword. The fourth and fifth chapters describe the four categories of weapons in the second chapter. The sixth chapter of the *Nitiprakasika* contains information about the composition of the army; role of war elephants, chariots, cavalry and infantry; and last about the general administration. Topics such as qualifications of officers systems of promotions, grant of pensions, and other connected matters are also dealt with. The seventh chapter enumerates the various types of army units and formations. The last chapter of the *Nitiprakasika* deals with the general duties of a king in governing and administering his kingdom. Several maxims on royal prerogatives and duties of his subjects are also specified.

7.5 The Dhanurveda

The *Dhanurveda* (manual of archery) is one of the four *Upvedas* (sub-Vedas) and dorms a part of the *Yajurveda*. It is essentially a manual of archery but it also deals with other contemporary weapons and their employment. Like most ancient Sanskrit works, the *Dhanurveda* also has a mythological origin, as mentioned earlier. Originally, the *Dhanurveda* was narrated verbally and at some unknown date it was recorded and soon many versions of it were produced.

It was some time during the fifth or sixth century A.D. that another great Hindu military classic was written, or collated, by an unknown writer or editor, possibly named *Siva or Sadasiva*. This was the so-called Siva-

Dhanurveda. Like other *Dhanurvedas*, which preceded and followed this work, its main theme is archery and the employment of the bow as the major weapon of Hindu warfare. This preeminence of the bow, in fact, caused the Hindus to use the term *Dhanurveda* to apply to all works on weapons and their employment. The Siva-*Dhanurveda* also deals with the employment of other weapons and with military sciences in general. Significantly, it repeats much that had appeared several centuries earlier in Kautilya's *Arthashastra*.

7.6 The Agnipurana

The puranas are 18 in number, but as sources of history not all are not important other than the *Vishnu Purana, Vayu Purana, Matsya Purana, Brahma Purana, Bhavishya Purana and Agni Purana*. They fill in the gap from the end of the epic ages to the rise of Buddhism. Mostly, they repeat certain chapters from previous books on the subject. The *Agnipurana* was compiled most probably in the eleventh century A.D. Four chapters are devoted to the *Dhanurveda*. It borrows from an author called Pushkara.

7.7 The Sukraniti

The *Sukraniti* is one of the main sources for this study but interpreting the data is a highly controversial issue. This version of the *Nitisastra* deals with the abstract problems of the state along with the details of administrative machinery. This deals with the duties and responsibilities of the king, ministers, officers and the administration of justice for the problems of foreign policy.

The *Sukraniti* (elements of polity) and the *Nitiprakasika* (mentioned earlier) were referred to by the German called Gustav Opperts to write the monograph – *The Weapons, Arms, and Political Maxims of Ancient Hindus*, with special reference to gunpowder and firerams. Although Oppert does not assign any specific date to the *Sukraniti* some scholars believe that it was probably written in the Gupta period – fifth to sixth century A.D.

According to Oppert, the *Sukraniti* is written by Shukracharya, also variously known *as* Usanas, Maghabhava, Kavi, Kavya, Bhargava, Sadasarichis, Dhaityaguru and Dhisnya. *Usanas* is also said to have written the *Nitisara*, a condensed version of the *Dandaniti*, an ancient work on civil and military administration.

In *The Mahabharata*, we read that Lord Brahma wrote the first *Dandaniti* containing 100,000 chapters. It was then reduced to 10,000 chapters by Lord Siva, called *Vaisataksa*. Indra reduced the size of *Vaisataksa* to 5,000 chapters and called it *Bahudandaka*. Then Brhaspathy reduced its size to about 3,000 chapters and named it *Brhaspatya*. Finally, Usanas condensed the *Brhaspatya* to about 1,000 chapters, which was known as *Nitisara*. Although the original *Nitisara* is said to have contained 1,000 chapters, no such work is now available, and it is quite probable that the *Sukraniti*, which contains about 2,200 verses, is either a condensed version of Usanas' *Nitisara*, or a part of it enlarged by Shukracharya.

The version of *Sukraniti* to which Oppert refers, comprised four sections, with a fifth supplementary section at the end. The first section specifies the duties of a king, the second that of the crown price; the third section pertains to income and expenditure on servants and wages, and the fourth section is subdivided into seven chapters laying down, respectively, maxims on friendship, enmity, treasury, administration, revue, arts, sciences, social laws, fortresses and the army. The last chapter of section 4 of *Sukraniti* is of importance to the scholar examining the ancient Hindu military system.

Many western military and arms historians, as well as some Indian scholars, have cast doubts on the authenticity of the *Sukraniti*, mainly for two reasons. First, this work could not be dated with reasonable certainty and, second, the descriptions of gunpowder and firearms given in it appear to be far too advanced for the period to which this work is generally assigned. A few scholars are also of the opinion that the entire book is a clever piece of forgery. These aspects will be examined later in this chapter.

Literary sources of historical importance dating before the fourth century B.C. do not mention large Hindu armies maintained on a permanent basis. Probably, the first we hear of such an army was of the Nanda King, who according to Curtis[99] had an army of 20,000 cavalry, 200,000 infantry, 2000 four-horsed chariots and more than 3000 elephants. Megasthenes gives an account of Indian life during the Maurya rule. He was the Seleucid Greek ambassador to the Maurya court at Pataliputra (now Patna). He spent about five years (304 to 299 B.C.) as the ambassador and left some accounts on the Maurya Government in particular. According to Megasthenes, Chandragupta Maurya or Drokottos (323-297 B.C.) maintained a large permanent military establishment, which was a part of the force of about 600,000 infantrymen and 30,000 cavalrymen. If we can depend on these figures, it would mean that the strength of the infantry was about twenty times that of the cavalry. In comparison, Alexander's army at the Battle of Gaugamela (now in Iraq) when he defeated the Persian Emperor Darious III in 331 B.C. was 40,000 infantrymen and 7,000 cavalrymen. Darious had a larger army, both foot-soldiers and horsemen, reinforced with 200 scythe-bearing chariots and few elephants. Alexander's success mainly depended on his superior tactics using both heavy and light cavalry to protect his infantry and act as his mobile arm.

Alexander, son of Philip of Macedonia, ascended the throne in 335 B.C. at the age of twenty years. After defeating Darious Codo Mannus, King of Persia, in the decisive battle of Arbela in 1331 B.C., he marched across and occupied modern Afghanistan and Bactria. Then he started the invasion of India personally leading the troops in the northern sector. He fought against the Asvayanas and Asvakayanas, where the latter is reported to have had an army of 30,000 cavalry, 38,000 infantry, 7,000 mercenaries and 30 elephants. After defeating the above forces, Alexander crossed the Indus at Ohind and accepted the submission of Ambhi the ruler of Taxila.

Porus, the king of Jhelam territory, refused to submit to Alexander and prepared to stop Alexander from crossing the river Jhelam and entering his

territory. According to Arrivan[100], Porus had an army of 30,000 foot-soldiers, 4,000 horsemen, 300 chariots and 200 elephants. Alexander defeated Porus at the battle of Hydaspes, by adopting superior tactics. Alexander then crossed the river Chenab (*Akesines*) and subdued the tribes inhabiting the region between the Chenab and Ravi. He then crossed Ravi and conquered the territories of Kathaioi (*Kathas*). When the armies of Alexander reached the Beas (*Hyphasis*), they refused to proceed any further and Alexander ultimately started retreating back. In 323 B.C., he reached Babylon near Baghdad where he died at the early age of 33. It is true that Alexander's campaign lasted for about 13 years and he stayed in India for about 19 months, but every moment of his life was eventful. His great empire was soon to fall into pieces within two years of his death and after the year 316 B.C. no trace of the Macedonian rule was to remain.

According to Megasthenes, Chandragupta's army mentioned above included 9,000 elephants, that is, for every twenty horsemen there was an elephant. Firdusi, in Sah-Nama, says that while Sikandar was marching against Porus, his troops became so frightened when they saw the large number of elephants. Alexander of Macedonia consulted his ministers and built a hollow image of an iron horse and a rider mounted on wheels. The stratagem recommended was to fill them both *naphtha* and propel them toward the approaching elephants and then explode the structure. The resulting noise and flesh was expected to frighten the animals and drive them away from the battlefield. As mentioned earlier, Alexander's army had faced elephants of Darious III in the Battle of Gaugamela. Perhaps the use of war elephants was one of the many causes due to which Alexander's victorious army, after a glorious march of nearly 25,000 kilometers from its home land, turned back from the farthest conquests.

During the Maurya rule, war elephants usually carried two to three men, including the mahout and the principal weapon used by them was the bow. Hannibal of Carthage at Trebia, Lake Trasimene and Cannae (216 B.C.) during the second Pumic War soundly defeated the Roman legions, using

the elephants to break up the opposing ranks. He had brought 37 elephants over the Alps into Italy.

Elephants were unreliable and posed constant danger when wounded, harming own troops more than the enemy's. They were used in India upto the influx of the Mughal invaders. Even after this, the Mughal rulers themselves learnt about their value and used them in warfare upto the period of Aurangzeb, but by then their importance in actual warfare was greatly reduced. Also due to the introduction of gunpowder weapons, elephants became useless in forwards echelons as they panicked easily when confronted with fire and explosions. They were ultimately relegated to the rear and were used mainly for battering down gates of besieged forts and cities, and to bridge unaffordable streams. Apparently, elephants were tied side by side facing the current for infantry men to walk over their backs to reach the opposite bank.

The Sumerians used chariots on battlefields as shown in Standard of Ur, dating from the third millennium B.C. In a relief from Ninevah (eighth century B.C.), the Assyrians used bowmen mounted on chariots. The Persians used chariots when they fought against the Greeks at Marathon (490 B.C.). Ramses II of Egypt used a bow from his chariot at the Battle of Kandesh in 1286 B.C. when he fought against the Hittites.

From the accounts of Megasthenes, it is obvious that the war chariot, drawn by four horses and carrying six men armed with bows that figures so prominently in the post-Vedic period had already started losing its importance. Apparently, soon after Alexander's invasion, the unwieldy chariot was found ineffective and useless while opposed by trained and competent infantry and cavalry. However, the war chariot continued to be used on the battlefield, undoubtedly with a steadily decreasing importance, for another thousand years or so.

From the *Arthashastra*, we learnt about the use of "arrows spitting fire," reminiscent of the *agneyastra* (fire missiles) of *The Mahabharata*. They were

undoubtedly arrows tipped with flaming combustibles and used to set fire to enemy installations and camps significantly, the *Arthashastra* does not mention firearms of any type. It is quite unlikely that Kautilya who was well versed about the employment of various types of weapons in warfare could have failed to mention firearms if they existed in his time. However, *Kautilya does mention the mahasara-yantra (machines discharging great arrows), bahumukha (many faced), jamadagneya (flame throwers), mahashila kantaka (stone-throwing catapults machines), rathamusalla* and *parigha* (battering ram), which are evidently siege engines and siege implements. Significantly, Alexander also used javelin-throwing machines and stone-throwing catapults during his invasion of India.

The *Arthashastra* tells that the Hindu kings relied on well-defended forts and fortresses to defend against raids of neighbors. Detailed instructions are given for the construction of various types of forts and their defenses. Stores and equipment to be stocked in such defensive positions are specified in detail. Siege craft is dealt with in this manual and the siege engines mentioned appear to use the principles of the catapult and bow.

Alexander returned from India with many lessons learnt in military tactics, and the Romans in turn benefitted by this knowledge to become a superb fighting force with a well-trained and disciplined force of infantry and cavalry, adept at fortifications and siege craft, camp layouts and field crafts, and use of siege implements and siege machines, such as missile-throwing engines and stone-throwing catapults. The Greeks took the ideas from Alexander and the Romans from the Greeks and they attained a remarkable degree of excellence.

The mahasara-yantra of Kautilya was the ballista of the Roman; both discharged javelin-like arrows with iron heads and with a ball of lead at the other end, and at times they carried flaming incendiary material. The *dronicapsara* was probably one such missile.

Kautilya described many methods of assaulting forts. He said "with the help of artificial stairs case obviously scaling ladders attempts should be made to reach the parapet and if strongly protected, machines, explosives and other material should be used to bring down the walls."

The *Arthashastra* also reveals that the Hindus showed neither interest nor competence in the use of the bow horseback. Perhaps the Indian horses had neither the stamina not the agility so essential for mounted archery tactics. However, they greatly relied upon infantry bowmen, and the horseman's principal weapon remained the lance and the mace for another thousand years or so. Just like Megasthenes, Kautilya also did not give any prominence to the war chariot.

According to Megasthenes, Chandragupta's army was composed of 600,000 infantrymen and 30,000 cavalrymen, and the ratio of cavalry to infantry works out to 1:20. The *Nitiprakasika* describes the *Patti*, the smallest army unit, with a strength of one chariot, one elephant, three horses and five men (*Nitiprasika*, VII, 5: Eco ratho, Gajashchaiko, Narah Panacha Haya Trayah) and larger units had multiples of these figures but in the same proportions. These strengths give us a ratio of cavalry to infantry of 3:5. The *Sukraniti* specifically mentions that the strength of infantry in an army unit should be not less than four times that of the cavalry giving a ration of cavalry to infantry 1:4 (*Sukraniti*) IV, VII, 20. These figures indicate that from the fourth century B.C. onward the cavalry started gaining importance, whereas the infantry gradually started becoming less predominant. When we consider the strength of elephants, the ratio of elephants to horses in Chandragupta's army was about 1:3, according to *Nitiprakasika* was 1:3 and according to *Sukraniti* was 1:32. These figures indicate the strength of elephants was reduced considerably by the period of *Sukraniti*. The chariot also became less prominent as the ratio of chariots to horses dropped from 1:3 (*Nitiprakasika*) to 1:64 (*Sukraniti*, IV, VII vv. 20 & 21).

According to the *Nitiprakasika* (VI.vv. 64 & 65), the role of the cavalry is "…to obtain knowledge of the woods, country and roads; to protect to

troops of the allies, and the forage; to disperse, and frighten the enemy by neighing; to follow near, and to go far away, to perform rapid movements and pillage the hostile troops." This implies that the cavalry was mainly utilized for roles such as reconnaissance, protection of infantry and mobile arm unit. Significantly, Alexander's cavalry tactics in the fourth century B.C. were also more or less similar.

From the time of Alexander's invasion to the period of Turko-Afghan invaders, the infantry's effectiveness increased and played a decisive role in battles, compared to that of the cavalry. Although in the West, after the Battle of Adrianople in (378 B.C.) and for the next thousand years or more the mounted horsemen dominated the warfare, and the infantry practically disappeared. In India, two factors were responsible for this; horsemen were unable to use the bow effectively from horseback and so relied on the sword and spear, whereas the infantry equipped with bows and arrows dominated the warfare. Second, an increasing weight of missiles from dart-shooting machines had made it possible for the infantry to break up the charge of a cavalry armed with only close-quarter weapons such as the sword and spear.

The *Nitiprakasika* also specifies the role of elephants in battles. Verses 59 & 60 of Chapter 6 read: "Experts declare that the work of elephants consists in marching in front, entering into forests making new and clearing existing roads; destroying fear-exciting appliances, breaking walls, carrying treasures, allaying the fear of and conciliating quarrelsome elephants." These verses indicate that elephants were by now withdrawn from the fighting elements and were mainly used for supporting roles.

The *Dhanurveda, Nitiprakasika, Sukraniti and Agnipurana* give us a fairly good idea of the weapons used in contemporaneous warfare. These weapons are invariably classified according to functional characteristic and employment. The *Dhanurveda, Nitiprakasika and Sukraniti* classify weapons into four main categories, namely, *mukta* (those discharged or hurled), *amukta* (those not hurled), *muktamukta* (those hurled as well as not hurled) and last *manutamukta* (those cast by spells or incantations). But according

to the *Agnipurana*, which appears to be a comparatively later work, weapons are classified under five categories (vv. 248 to 257), namely, *yantramukta* (projected or discharged by machines), *panimukta* (those hurled by hand, *muktasandherita* (those hurled and then withdrawn), *amukta* (not hurled) and *bahuyuddha* (those for hand-to-hand combat).

The manner in which the weapons are classified in the above works as well as the weapons grouped under each classification provides valuable clues to ascertain the approximate period when certain new types of weapons were introduced and when certain out moded weapons were discarded.

For instance, the category of *mantramukta* (weapons cast by spells or incantations) weapons is not given in the *Agnipurana*, which indicates that by the time *Agnipurana* was compiled weapons grouped under this category were rendered obsolete. Similarly, the *muktamukta* category was also deleted and in its place the *muktasandherita* class (those hurled and then withdrawn) was substituted. Also, three new types of weapons were introduced, that is *yantramukta* (discharged by machines), *panumukta* (hurled by hand) and *bahuyuddha* (weapons for hand-to-hand combat). Now, the classification is more distinct and the nomenclature of these categories becomes self-explanatory.

Certain weapons mentioned or described in the Sanskrit works are of special interest to arms historians and are discussed in the following pages. The earliest of these are the arrows, darts and javelins carrying flaming incendiaries and discharged by means of bows, sling and more often by hand. Larger and heavier versions of such fire missiles were also devised along with suitable machines to discharge them. They were mainly used for assaulting as well as defending fortified positions such as forts. In the epics, incendiary arrows were generally termed as *agneyastra*. Manu calls them *agnivalitatejanaih* (darts kindled by fire) in his *Manusmriti* (VII, 90, Section VII, Verse 90). Kautilya mentions “arrows spitting fire” to set fire to enemy installations. In *Nitiprakasika* (Chapter V, vv. 53 & 54) machines made of steel, stone and other materials, other throwing materials such as balls on

the enemy, big rocks, saws, smoke balls, burning husks of corn, hot and boiling oil, melted sugar, resin of sal trees, and pots filled with honey and poisonous serpents are mentioned. Such missiles are also mentioned in *The Mahabharata* (Adiparva, 155, 5 to 6). Ashdown[101] wrote about medieval projectile-throwing engines: "They (missiles) were not always of stone, but barrels of Greek fire, pitch, *naphtha* and other inflammable substances were used; also occasionally the bodies of dead horses and other animals, often in a state of decomposition."

The weapon *gosirsa* (cow's horn), mentioned in serial four of the *amukta* class in the second chapter of the *Nitiprakasika*, was originally a thrusting staff weapon, with a horn-shaped main blade, from which it derived its name. Significantly, the European weapon *Guiserme* or *Geiserme*, mentioned regularly in French and English texts from the twelfth to fifteenth centuries, was apparently a similar weapon and from this weapon was developed the halberd and *bardiche* of the sixteenth century. The name *Guiserme* in English appears to be synonymous the Sanskrit's *gosirsa*.

Serial 20 of the *amukta* class of weapons is the *satghi* (literally *sat* means a hundred and *ghni* means to kill), which is considered synonymous to the weapon called *surmi*. Both *satghni* and *surmi* are mentioned in the *Krishna-Yajurveda* (V:4 & 7); the latter is mentioned in the *Rigveda* (VII, 1 & 3) and *The Mahabharata* (Adiparva, 209: 29: 32) (Pratapa Chandra Roy edition, VoI. I,pp. 463 & 464). The *satghni* is also mentioned in the *Raghuvamsa*.

Many Sanskrit scholars consider the *satghni* to be a firearm, but according to the *Nitiprakasika*, it is shown under the *amukta* class of weapons (weapons not hurled) and so it is was not a projectile weapon. Furthermore, verses 48 and 49 in Chapter 2 of the *Nitiprakasika* describe the *satghni* as thorny, black in color, hard, looks like a *mudgara* (war-hammer or mortel-de-fer), four cubits long (about two meters), round and provided with a handle. According to Vysampayana, it resembles the *gada* (a mace-like club). Probably, the *satghni of Nitiprakasika was a* weapon similar to the holy water sprinkler of Europe.

The *satghni* is also mentioned in the *Harivamsa* as *satghnibisca diprabhis* (killer of a hundred and lighted by fire).This led some scholars to believe that it was a weapon ignited by fire, hence a firearm. In this context, the *satghni* was obviously a missile like an iron quarrel tipped with flaming combustible and discharged by a machine, probably of the crossbow type.

However, the preface to the much discussed Gentoo Laws or Ordnances of Pundits (Nathaniel Brassey Halhed, from a Persian translation, made from the original written in Sanskrit language, London, 1770, pp. LII & LIII) mentions: "Cannon in Sanskrit idiom is called '*Shet-Aghnee*,' or a weapon that kills hundred men at once, from '*Shete*,' a hundred, *and 'Gheneh,'* to kill."

Raghunatha Panditha, in his work *Rajavyavahara-kosa*, which was composed in 1676 by the order of Shivaji the Great, recorded the terminology of firearms in the *Sastravarga*, v. 130, in which the weapon *satghnika* is also included. The verse reads:

"Tophnam bhavedulka daro namagnichurakamu

Laghuyantram jabarjung yantura tu satghnika"

These two references indicate that at least by the seventeenth century the *satghni* was a large iron missile or bolt fired by cannon.

In the *Krisna-yajurveda* (I: V; Vii; 6), the weapon *surmi* is described: "This is the surmi which has a hole like an ear, with it the Gods killed the *asuras* (demons) by the hundreds. As the sacrificing priest kindles with his surmi-like verse the firewood, he throws also on the enemy the satghni-like mantra, which resembles the thunderbolt of Indra."

Verse 19 of Chapter 6 of the *Nitiprakasika* reads: "A king should keep at the rear) the treasury, armory for the small weapons, arsenal for machines (*yantraghar*), granaries, stragglers, and all the exhausted animals." The term *yantraghar*, meaning an arsenal for machines, also occurs in *The Mahabharata* (*Shantiparva, Rajadharma*, LXIX, verses 53 and 54). Verse 47 in the same chapter mentions the items to be kept in readiness for war,

"bowstrings, bows, armor, weapons, triangular bows, big machines, iron arrows…" The triangular bows and big machines were obviously crossbows and siege engines, respectively, and the iron arrows were quarrels or bolts, their projectiles. Furthermore, after mentioning the various paraphernalia and arms, Verse 51 mentions: "…and also the cotton of the silk-cotton tree and iron jointed with flint." (*Salmalitulikam cava vopyasma sarsmasam yutam*.) These implements are essential accessories to light the *slowmatch* for igniting the cannon.

Verse 28 of the sixth chapter of the *Nitiprakasika*, as translated by Oppert reads as follows: "A king should place behind and near him well-bred, fleet and fiery riding and chariot horses which are clad in mail (armor)." From this it is evident that riding and chariot horses were protected by mail in the period of the *Nitiprakasika*, signifying the value attached to horses as well as the types of weapons used at that period in battle. In the European armies, cavalry horses were protected with mail soon after the introduction of the deadly crossbow and longbow.

The *Nitiprakasika* specifies several military maxims on military tactics and strategy. Verse 56 of the sixth chapter says: "The king should make these two (horsemen and charioteers) capable of fighting from the back of elephants, all of them he should transform into foot-soldiers, and the latter he should use as charioteers and elephant-soldiers." Significantly, the necessity to train horsemen, elephant-soldiers and charioteers to fight as infantrymen had arisen by this period. In Europe, similar tactics were adopted during The Crusades.

Dupuys wrote about the European military history of the period 1000–12000 A.D. He said, "even prior to the Crusades western Europeans had discovered that – all things being equal – an army which includes a reliable foot element provided a base of maneuver for the cavalry, because the infantry could seize and hold commanding or vital ground. For this reason, many European leaders would habitually dismount a portion of their knights and men-at-arms to fight on foot. Sometimes the only foot element

of an army would be its dismounted knights. The reason for this was that it was uneconomical to use expensive cavalry, a kind of medieval intuitive cost effectiveness (considering the fact that the best cavalry horses were still drawn from the north or from Arabia) led to development of standing forces of well-equipped, disciplined infantry. This phenomenon was accelerated by Crusade experience. In fighting the mobile Moslems, the Crusaders found it essential to maintain a solid infantry base from which to launch their overwhelming cavalry charges. The significance of this was soon realized by the Molems, who then made it one of the important objectives to separate the Crusader cavalry from the infantry, and then to defeat each in detail. This is how Saladin won his decisive victory at Hattin. This Moslem tactic, in turn, taught the Crusaders to devote more attention to close coordination of the actions and movements of both infantry and cavalry, leading to really effective operations of the combined arms as in Richard's great victory over Saladin at Arsouf. Part of this coordination of the foot and horse elements were centered round the related concepts of fire and movement. Reliance upon crossbow was generally accelerated by the Crusaders' experience, and by their realization that they needed firepower to offset that of the Turkish horse archers."

A survey of Sanskrit literature would indicate that from time to time certain weapons were placed under interdicts as objectionable weapons in warfare. For instance, Manu's law book, Section 7, Verse 90, reads:

"Na kutairayudhairhanyat yudhyamano rane rip un;

Na karnibjir napi dighair nagijvalitatejanaih"

This verse according to Kullakabhatta, commentator of Manu and who was active in the fifteenth century, means: "No one should strike in a combat his enemy with concealed weapons, nor with barbed arrows, nor with poisoned arrows, nor with darts kindled by fire." Whereas, according to the *Nitiprakasika*, Chapter VII, Verse 45, the same maxim is expressed by Vysampayana as under:

"In combat no one should strike his enemy with concealed weapons, or with poisoned arrows, or with machines kindled by fire (*agnyujvalair yantraih*)."

When verses 89 to 90 of Manu's law book are compared with those of the *Nitiprakasika* 44 to 46, Chapter VII, it would be seen that these two sets of verses are exactly the same excepting that in verses 90 of the *Manusmriti* the words *agnyujvalitate janaih* (darts kindled by fire) are used, whereas in Verse 45of the *Nitiprakasika* these words are substituted by the words *agnyujvalair yantraih*, which according to Oppert mean "machines kindled by fire." But the literal translation of these words mean "fire-flame-machines," signifying flame-throwing machines. Thus, in the days of Manu the incendiary, or fire, dart (or arrow) was sentenced unfit for warfare and an interdict was placed against its use. But by the time the *Nitiprakasika* was composed, this interdict was lifted. However, by this period another objectionable weapon was devised, the flame-throwing machine, and Vysampayana considered this an objectionable weapon and prohibited its use in warfare.

There are reasons to believe that a crude form of the Greek fire was known to the Hindus that they discharged with flame-throwing machines. The Greek learnt about this when they invaded India in the Maurya period and passed this knowledge to the Romans. The Greek fire was then perfected by the Byzantines by the seventh century A.D. and they used it extensively in both land and sea warfare. A rare Byzantine compilation of the tenth century, based on the early military treatises by Apollodorus, Biton, Hieron and others, shows an illustration in which Greek fire is used against an enemy tower (Plate 16/7).

In the European military history, we also find several interdicts imposed from time to banning the use of some weapon or other. For instance, the Church, in 1139 A.D., considered the crossbow a barbarous weapon – "Hateful to God and unfit for Christians." – and forbade its use among Christian nations. However, Richard of England and Philip Augustus of

France had sanctioned its use during the Crusades. Similarly, when the wheel lock was introduced there was a pronounced increase of crimes of violence involving wheel locks, for the simple reason that these firearms could be easily concealed and carried after fully loading and priming. Therefore, rigid laws controlling their use were promulgated in many cities of Austria, Italy and England in the early 1500s. Many deplored the use of firearms. "O cursed device base implement of death!" Exploded Aristo. In the sixteenth century Blaise de Monluc, Marshal of France, called the arquebus, "The Devil's invention to make us murder one another." There is also on record that the English monarch Henry VIII forbade the use of lead shot in firearms by any one less than a Baron. However, all such interdicts were lifted gradually as the concerned weapons gradually gained popularity.

When we examine the Sanskrit literature, we also find that firearms were banned in warfare soon after their introduction, just as fire missiles and flame throwers earlier. For instance, according to Halhed's[102] version of the Gentoo Laws or Ordnances of the Pundits, the following interdict is laid down:

"The magistrate shall not make war with any deceitful machines, or with poisoned weapons, or with cannon and guns, or any other of firearms…"

One important weapon appeared, at some unknown date, on the Indian battlefield, possibly just before the *Kamandakiya* was composed, usually called *nalika*. Obviously, it was a generic term for a group of weapons with a tube of sorts as a major component. The Sanskrit words *nal, nalika or nali* normally mean a tube such as a piece of hollow bamboo or reed. The Hindi word *nal* is still applied to a grassy with a thick and hollow center stock, resembling a shoot of bamboo or cane. It grows in the marshy areas, such as jheels, along the banks of north Indian Rivers.

Hollow bamboo pieces were used in India from ancient times to make firecrackers and crude rockets. Soon such firecrackers were reinforced with tightly wrapped twine, rattan, hemp, jute or wire so that they exploded with

loud reports and brighter flashes than the simple firecrackers. As they were shotless, they were used on battlefields as psychological weapons to frighten horses and elephants. Such weapons are now generally classified as military pyrotechnics.

Soon the feasibility of utilizing the force generated by an exploding charge in military pyrotechnics was explored and the Roman candle principle was discovered. In a Roman candle type of weapon, a reinforced piece of bamboo tube was plugged at one end and loaded with alternate layers of combustible powder and incendiary ball – usually of tallow or *naphtha*-soaked wad – until the tube was full to the top. It was then ignited at the muzzle and as the fire worked round each ball it touched off the powder to launch the ball ahead, until all the charges are fired one after the other. As an offensive weapon, it was not effective due to the limited range and hitting power of the projectiles. There was also the danger of all the charges going off together and bursting the tube itself – the so-called Roman candle effect.

Perhaps along with the Roman candle type of weapons, the possibility of modifying the simple firecracker to project solid missiles was also experimented. In these weapons, the reinforced tube was closed at one end with a mud or wooden plug through which passed a wick or fuse. The tube was then filled partially with an explosive, such as gunpowder, over which was placed a small arrow, or a ball of lead, stone, or clay. When the wick was set alight, it ignited the charge to explode and to eject the projectile out of the tube. The result was the invention of proto-firearms – half-way between a firecracker and firearm.

The weapons described above had one common component – a piece of tube and so the name *nalika* or *nalikam* was applied to all of them whether it was a firecracker, flame-thrower, military pyrotechnic, or proto-firearm. By the time the proto-firearms were developed into firearms, the terms *nalika* or *nalikam* were usually prefixed with other qualifying words.

The earlier reference to the weapon called *nalika* appears in the *Kamandakiya* (Chapter V, Verse 51), which reads:

"Panastridyutagosthisurajanam abhtasuchar

Bodhayeyuh pramadayantam upalair nalikadibdhi."

Oppert's translation of this verse reads: "(The bodyguards) near the king should rouse him by stratagems, gun-firing (nalikadibdhi), and other means, when he is indulging in drinking bouts, among women, or while gambling." Here the *nalika* is obviously a shotless noise-making tubular weapon – a military pyrotechnic.

According to the *Nitiprakasika* (Chapter II, vv. 17 & 18), the class of weapons are twelve in number: the "*dhanu" (bow), "isu" (arrow) "bhindivala" or "bhindipala" (sling), "sakti" (lance or javelin), "dhrughana" (battle axe), "tomara" (throwing hatchet), "nalika" (tubular weapon or tube), "laghuda" (mace), "pasa" (lasso or noose), "chakra" (discus), "dantakantaka" (bill or military fork), and "masundi" (morning star or Morgenstern). Here the nalika is classified as a weapon to be hurled or projected, as was also the bow (dhanu) and the arrow is also shown separately in the same* category of weapon. But the projectile discharged by the *nalika* is not mentioned separately.

Verses 40 & 41 of Chapter IV of the *Nitiprakasika*, describe the *nalika*:

v 40. Nalikarjudeha syat tancangi

madhyarandhrika marmacchdhakari

nila dronicapasareini.

v. 41. Grhanam dhamapanam caiva

syutam ceti gatitrayam

tam asritam veditva tu

jetasannam ripun yuddhi.

Oppert's translation of the above verses reads: "It has a straight body, is thin limbed, and hollow in the middle. It pierces the vital parts, is dark, and discharges the missile *dronicapa*. When it is to be used, it is taken up, ignited, and pierces the mark. These are the three actions connection with the nalika."

According to Oppert, the *dronicapa* mentioned in this *sloka* is a missile, such as a dart or ball, discharged by the weapon *nalika* – an arrow or ball shooting firearm. However, no mention is made in these *slokas* about explosives loaded in the *nalika*. Most probably this missile was an incendiary dart or arrows discharged from a tube after setting it alight, and, therefore, the *nalika* mentioned in the *Nitiprakasika* was probably an incendiary arrow or dart-shooting tube. This in turn would suggest that the noise-producing and shotless *nalika* of the *Kamandakiya* was modified by the time the *Nitiprakasika* was compiled into a tube discharging fire darts or fire arrows.

A twelfth-century work *Naishadha* composed by Sriharsa also mentions the weapon *nalika*:

"Dhanusi rati panchanayoruditi visvajayaya tadbruyau

nalika taducchanasika tvayi nalikavimukti kamayo."

Here the *nalika* are bows of the two legendary cupids, Rati and Manmatha, which were fitted with tubes through which they discharged harmless missiles. They were by no means fire weapons or firearms. The poet had mentioned bows fitted with tubes and he was obviously aware of bow-like weapons fitted with tubes through which spherical missiles were discharged.

In the *Sukraniti*, weapons called *nalika* and *nalikam* are mentioned in verses 132, 133, & 135, of Section IV, *Chapter 7 (Oppert's version).*

v.132. "Astram tu dvidham jheyam nalikam mantrikam tatah"

v.133. "Yada tu mantrikam nasty nalikam tatra dharayatsana

sastrena nrpatirvijyartham tu sarvada"

c. 135. "nalikam dvividham jneyam brhatksudrvibhedatah."

Oppert translates these verses as follows:

v.132. The *astram* (projectile weapon) must be known to be of two kinds, that consisting of *nalika* (tube) and that thrown by incantations (mantrikam).

v.133. If there are no *mantrikam* (incantation arms), a king should always keep for the sake of victory the *nalikam* (tubular arms) together with other weapons (*sastra*).

v.135. *The nalikam (tubular weapons) should be known as being of two kinds, divided into brhat (large) and kshudra (small).*

Here, the weapon *nalika* appears to be a tubular projectile weapon, quite distinct from the projectile weapon, which discharged missiles by incantations or spells (which in the modern sense could only be a weapon discharging projectiles in a mysterious manner). The two types of tubular projectile weapons large and small – will be examined later in detail. The *Sukraniti* also gives the formulas of *agnichurnakam* (gunpowder) for use with such weapons. The *nalika* was therefore a firearm as it projected missiles by exploding a charge of gunpowder.

The Sanskrit work complied after the fifteenth century A.D., mentioning the weapon *nalika* is The *Rashtraudhavasamahakavya*, composed by a Dakshinatya poet Rudrakavi, at the court of the Bagalan king Narayana Shah in 1596 A.D. (Verse 52 of Chapter XX reads):

"Shitsaurupalairat nalikavinihat jvaladaisagolikaih,

Militayorubhayorath senayohpravarvate samarastumulasthayoh."

In this verse, the terms *ayasagolikaih*, *nalikavinihat*, *shitasaraih* and *upalaih*, meaning respectively, iron cannon balls, gun, sharp arrows and stones or gravel, are mentioned. Here, the *nalika* is definitely a cannon firing

iron shells charged with sharp arrows and stone balls, which was used by about the end of the sixteenth century A.D. The *nalika* meant a cannon.

The *Rajavyavahara-kosa* composed by Raghunatha Panditha by the order of Shivaji the Great, in 1676, mentions weapons called *nalikam* and *nalika* in verses 129 to 131:

v.129. Yantrayuhastvaraba syadu baneagini-nalika bhavetu,

nalikam barakandajam nalikayantra tubandukamu,

v.131. Geptinedh bhavetu kana golandaj yantravedak.

(Arrow projected by machines are fire arrows of *nalika*; *the nalikam, barakandajam and naliyantram* (tube machines) are bunduks; *deptinedh* means *kana* or bore; *golandaz* means *yantravedak mena gunner or artillery man*; *yantravyuha stva-rabha* means discharging fire arrows; *naliyantra mena banduk.*)

Chaturdharam one of the early commentators of *The Mahabharata*(c. 1650–1700 A.D.) refers to *nala* in the following passage:

Yantrani agneyaushadhabalena seesa-kamasyadrishadgolprakasepakani lohamayani bhasayam nalashabdhabhi dhreyani team sotrah sunchacham satramu.

Here, it means: "A machine made of iron and capable of ejecting by force of a fire powder (gunpowder), balls of lead, bronze and stone."

According to Verse 135 of Section 4, Chapter 7 of *Sukraniti*, the *nalika* is of two types – the *brhatnalika* and *ksudranalika*. The former is a large *nalika* or a weapon with a long or heavy barrel (tube), and the *ksudranalika* is a small projectile tubular weapon, or one a short or light tube (barrel). These names *brhat* and *ksudranalika* occurs only in the *Sukraniti*. The terminology for these two types of *nalika* mentioned in other Sanskrit works including the *Sukraniti brhannalikam* or *brhannala* for large smaller tubular weapons.

The *brhannalikam* is mentioned in Verse 21, Section IV, Chapter 7 of the *Sukraniti*: "…for every 4 camels 1 elephant, for every two elephants1 chariot,

for every chariot 2 brhannalikam."

The *brhannala* is mentioned in IV:7:140: "A Nrhannalika is called the tube which obtains the direction of aim by moving the breech with a wedge; its end is without wood; but it is to be drawn on carriages; if well welded it gives victory." Here *brhannalika* means a cannon.

The *laghunalika* is mentioned in *Sukranati* IV:7:32: "(A Prince) should maintain well with 'Sastras' (weapon) and 'Astras' (missiles or projectile weapons), and 100 men, 300 foot-soldiers with laghunalikai." This verse could also be interpreted to mean "100 men, 300 foot-soldiers with laghunalikaai" and "100 men with Sastras and Astras, and 300 foot-soldiers with laghunalikai" (light tubular projectile weapon – firearms). IV: 7:138 says: "After the gunpowder (*savanegnuchura*) is placed inside, it firmly pressed down with a ramrod. This is the *laghunalikam* which ought to be carried by foot-soldiers." Here the *laghunalikam* is applied to a portable firearm. The term *laghunala* is mentioned in IV: 7:14: "The ball is made of iron, and has either iron balls in its inside or is empty; for Laghunala it should be of lead or other metal." Here, the *laghunala* also means a musket.

The *laghunalika* is also mentioned in a work called the *Yavanaparipati-anukrama*, composed by Dalapatiraya, in about 1764, in a draft of a letter addressed by king Madhavasimha to the commander of artillery, ordering to make the artillery ready for action.[103]

Apart from the above mentions, the terminology incorporating the term *nalika* in Sanskrit works, particularly those written from the fifteenth century onward mention firearm terminology with word *nalika* prefixed by some other terms. They are given in the verses mentioned below:

The *Bharatacampu or Campubharata*, composed by Anantabhatta, or Harikavi in c. 1500, the *kalambudhalinalika* (*nalika* lighted or ignited by a fuse or match) in stabaka III, Verse 54 (p. 113, N.S. Press edition, Bombay, 1903, quoted earlier by Gode). The verse reads:

"*Kalambudhalinakat ksanadiptivarttayam*

Sanduksitast sapadi sadavaninissaradbhih;

Varasasmassisugulikanikaraihgharmabhiyatim

Avadhit ghanakalyodhah."

A translation of this verse reads: "The fierce warrior who killed his enemy with heaps of lead balls, which emerge quickly from the 'nalika lighted by a fuse,' is like a rainy season which killed the summer with hailstones which descended quickly from the rows of black clouds lighted by lighting." Here, the *kalembudhalinalika* is a matchlock.

The *Sambhuraja-charita* composed by Harikavi, alias Bhanubhatta, in1685 A.D. (MS. No.191 of 1875–1876, Folio 71a, 72b & 92) mentions firearms called *sutalnibhnalika* and *bahalanalika*:

v.27, Folio 71a:

"*Tatah samabhavadrava prahatbhuribheribhavah*

Sutalnibhnalikagadagadadrav bhrajitah,

Vilolitmahitalo bahalagarjitabrasthlo

Ninad eev megajh kulisaravasanrajitah."

v.71, Folio 72b:

"*Sastravarsambhrutam bahalnalikasankulam*

Sankatbhatodgaram prabhalkunjragresaram,

Ranedgetaturangmodgamatarangarangottaram

Chakasra parvahittom prativaruthinem svamtatah"

v.91, Folio 92:

"*Tato nrupatisainyatobahalnalikakrato*

Maharavavidharitaksyavanamastaka niryayau,

Sogolakatatiksaladyumanimalikevodgata

Ripvrajpatakinem sapdi nirdhahanati hatatu."

A translation of Verse 91 reads: *"A series of cannon balls (sogolikatati) issuing from the mouths of cannon (nalikavakatraudgata), and looking like a row of sons, destroying the army of the enemy."*

In the above passage Bhanubhatta uses the terms *sutalnibhnalika* (white nalika) and *bahalnalika.*

The draft of a letter addressed by king Madhuvasimha to the commander of his artillery, dated 1763, mentions some firearms the names of which include the word *nalika*. They are, *dvitiyendra dvajakaren-mushtranalika*, *hayanalika* (*nalika* carried on a horse) and *gajanalika* (*nalika* carried on an elephant).

The Rajavyavahara-kosa, composed by Raghnatha Panditha, in 1676,Verse 130 reads:

"Top nam bhavedhulka daro namagnichurnakamu,

Laghuyantram jabarjang jambura tu satgneka."

Here, according to Raghunatha the *laghuyantram* (light machine), *jabarjung and jambura*, all mean *satgnika-cannon*. The zamboorak was light cannon. A zamboor is a bee or wasp, and as the shot of this weapon hurts like stinging of wasps or bees – hence the name. According to Bernier, these cannon were fastened on backs of camels and are swivel guns firing the ball about 1 seer (about 2 pounds) in weight – hence demi-culverin.

In addition to the above firearms terminology, the following terms are also found in Sanskrit texts of the late medieval period. They are *nurmal* (musket carried by an infanteer), *philnal* (firearm mounted on an elephant), *sutarnal* (firearm mounted on a camel) and *ustranal.*

Weapons called *nalastra* and *nalastram* are also mentioned in Sanskrit works. We have already seen that according to *Sukraniti* (IV:7:131), the *astra* was a missile discharged by incantations (spells) or by machines or fire and differs from the *sastra*, which is either a cutting, thrusting, or hitting weapon, such as the sword or spear.

According to *Sukraniti* IV: 7:132, the *astra* if subdivided further, then it is called *nalikastra* and *mantrukastra*. Such missiles or weapons are mentioned in the following works:

The *Sukraniti* (IV: 7: 145) describes the *nalastram* as made of either iron or any metal. It rubbed, cleaned and covered by gunners everyday. Here, the *nalikastra* is applied to the projectile weapon itself and not to its projectile. Verse 150 of Section IV, Chapter 7 says: "One could clean the nalastram first and then put gunpowder, carry it down with a ramrod to the bottom of the 'nala' (tube or barrel) till it is tight." In this verse, the *nalastram* is a projectile weapon. Verse 266, IV: 7 says: "The best fight is with 'mantastra,' the middling is with nalastra……" And Verse 269, IV, 7 reads: "The destruction of the enemy which takes place by means of lances and other Sastram is to be known as combat with sastram (sastrayuddham), in the absence of nalastra." Here, the *nalastra* appears to be projectile weapons and not missiles.

Verse 271, IV; 7 of the *Sukraniti* reads:

"Nalastrani puraskrtya laghunalika mahantica

Tat prsthagansca padatam gajaswan parasvayoh stitam

Krtva yuddham prarabheta bhinnamtyam balarina."

The translation of this verse in English reads: "Having placed the small Nal and the big guns in front and behind them the infantry, and on the two flanks elephants and horses, he should begin the battle, when the hostile army and ministers are disunited." Here again the *nalastra* is a firearm rather than a missile.

The *Akasabhiravatantra* (Folio 189, Bhandarkar Oriental Research Institute Pune, MS. No. 43) was most probably composed in the prosperous days of the Vijayanagar period, the 1500s. In the 60th chapter of this encyclopedic work, the king is advised to worship 32 weapons on a particular day and among these weapons, at serial 24, is mentioned:

"*Tryaovimsam nalikastram svastikam tadanantram*." Here, also the *nalikasttam* is a weapon and not a missile.

Thus, we find that originally the *astra* was a missile but later when it was used in conjunction with the terms *nal* or *nalika*, it meant a projectile weapon such as a firearm. The significance of this is quite obvious, that is, when a projectile or missile was an arrow or dart discharged by a bow or some mechanical projector it was known as an astra. But later, when tubular weapons such as firearms were introduced their projectiles generally consisted of stone or metal balls and so the weapon was called a *nalastra* or *nalastram*. This in turn would lead to the inference that the *Sukraniti* is the first known work dateable to a period after the gunpowder weapons were introduced.

The *Sukraniti* describes a gun carriage, for the first time we know of, in verses 30 & 31, IV: 7, which read:

"Lohasaramayah chakrasugano, manchaksanah,

Scandatayitarudhestu, Madhya-nasamasarathu,

Sastrastra sandharya dara istacchayo manoramah

Evamividho ratho rahna raksyo nityam sadasvakeh."

This verse could be translated as: "An iron-made carriage, well going on wheels, provided with a couch as a seat, on which is fixed a swing, with the charioteer on the middle seat; with an interior carrying weapons and missiles, giving adequate shade and beautiful – such a carriage provided with good horses should be always kept ready by the king."

A critical study of the *Nitiprakasika* and *Sukraniti* would reveal the following:

1. Verse 5 of Chapter VII of the Nitiprakasika says: *"Eko ratho gajascaiko narah pancha haya trayah,"* that is, the smallest army unit – the *Patti* – should consist of one chariot, one elephant, three horses and five men. The larger units have multiples of these figures but in the same

proportion. This gives us a ration of the cavalry to infantry of 3:5. Whereas according to the *Sukraniti*, verses 20 & 21: IV; 7, the composition of an army unit should be two brhannalika (big guns), one chariot, two elephants, eight camels, 64 horses, 13 bulls and 256 foot-soldiers, which is nearly equivalent to the present day infantry company. The *Sukraniti* also specifies in the Verse 20, Section IV, Chapter 7:

"Chaturagunam hi padatam asvate dharayat sada
Panchamano sastu vrsaban astamasansca kramelakam"

A king should always maintain four times as many foot-soldiers as horses. Thus, compared to the times of the *Nitiprakasika*, the percentage of the infantry in the Hindu armies more than doubled by the period the *Sukraniti* was compiled, indicating the ascendancy of the infantry over the cavalry, or in other words the importance of cavalry started declining after the *Nitiprakasika* was composed. Although in the fourth century B.C., the ration of cavalry to infantry of the army of Chandragupta Maurya was 1:20. It is also of interest that by the time the *Sukraniti* was composed, apart from the horses and elephants, other animals such as camels and bulls were inducted for military use, use of these animals for military purposes became a common feature. However, Shukracharya gives a general direction about the strengths of these animals in Verse 22, Section IV, Chapter 7:

"Padatibahulam sainyam madhyasvam tu gajalpakam
Tatha vrsostrasamanyam rakset nagasdikam na hi."

A translation of this verse reads: "Here (the king) should keep an army with foot-soldiers, with a modest number of horses, but with few elephants; likewise with a small number of bulls and camel, but now with many elephants."

2. According to the *Sukraniti* IV: 7: vv. 23 & 24, a prince should maintain 100 men armed with *sastras* and *astras* and 300 foot-soldiers armed with *laghunalike* – the so-called light (portable) firearms. Here, the strength of an army unit is specified as 80 horses, 1 chariot, 2 brhannalikam, 10 camels, 2 elephants, 2 wagons and 16 bulls. A wagon, probably for

carrying ammunition for the guns, is included in the transport for the first time. Another major departure is the induction of 300 hand gunners with only 100 infantrymen armed with other weapons. This would mean that about 75% of the infantry was armed firearms (*laghunalikam*), whereas only about 25% were armed with other weapons (*sastras* and *astras*).

3. According to *Sukraniti* Section IV, Chapter 7, Verse 271, the order of battle suggested was "laghunalika (light firearms) and brhannalika (heavy firearms) in front, behind them the infantry, and on both flarks horses and elephant." Whereas, according to *Nitiprakasika*, Chapter IV, Verse 12: "A king who ranges (his troops) in the battle order with elephants in the front, chariots behind, horses on both flanks, and at the rear the infantry, ought to be victorious." Here, the infantry is in the rear of an advancing force with the chariot leading. The major changes in the orbat of an attacking force according to the *Sukraniti* was that the infantry armed with light and heavy firearms were taken forward, with the rest of the infantry behind them, and the cavalry and elephants were shifted to both flanks and rear of the infantry. The chariot was obviously used as a carriage for the king, or commander of the force, and was not a fighting vehicle.
4. Verses 238 & 255 of Section I mention that royal watchmen who are on duty about the palace carry firearms. Talboys[104], also mentions, "(fort walls) are always guarded by sentinels provided with firearms, and other projectile weapons…"
5. Verses 136 to 138, Section IV, Chapter 7, *Sukraniti* describe the *laghunalikam* (light firearm). It is said to have a tube (barrel) about five spans long (about 45 inches – one span being the distance between the tips of the thumb and little finger when the right palm is fully spread out – a distance of about 9 inches). The diameter of the bore at the breech end of the barrel is about ¾ in. The vent is drilled vertically at the breech and both front and rear sights are fitted to the barrel. It is fitted with wooden stock. The mechanism (lock) makes fire by sticking. Mention is also made that the firing mechanism carries stone and powder at the breech. Many arms historians consider that the firing mechanism described is the

flintlock was invented in Europe at the beginning of the seventeenth century.

The earlier European document mentioning a gun of the type that is kindled by a stone is a letter from the steward of Cardinal Ippolite de Este I, dated 1507, ordering for one such gun from Germany. Therefore, some western scholars are of the view that the *Sukraniti* must have either been composed in the sixteenth century, or the verses describing firearms must have been interpolated in the sixteenth century or after. However, they overlook the fact that the *Wu Pei Chih* and *Wu Ching Tsung Yao* also mention multifire and cartridge firing firearms much before they were known to the Europeans. We have already seen that the *Nitiprakasika* (VI:55) mentions that flint and steel are to be carried by soldiers, and so it is not very surprising if they used the principle of utilizing the spark by flint and steel directly to ignite the priming powder in the pan of a firearm.

The scanty descriptions of firearms given in the *Sukraniti* give an impression that the author was not fully conversant with the working principles of firearms he was attempting to describe. This is not very surprising as the learned Brahmin was undoubtedly not fully acquainted with the mechanical intricacies involved. The *Sukraniti* was not a technical manual and firearms and their use are mentioned by Shukracharya casually. Such mechanical details were known only to the craftsmen who made firearms, and in the typical oriental manner they were not very keen to disclose technical aspects of weapons they devised, particularly about firearms, for the fear of disclosing their trade secret. Perhaps this is also the reason for the general feeling that the authors of the *Wu Ching Tsung Yao* and *Wu Pei Chih* were also not fully aware of the functional aspects of firearms they were attempting to describe. This was also the case with European sources as although the first illustration of a crude firearm appears in an English treatise of 1326, no other documents describing the constructional or functional aspects exist for another hundred years or so.

Early gunpowder weapons were not considered very effective weapons in warfare, hence their use was restricted and their efficacy valued but little. They were mostly used as psychological weapons, the flash, smoke and bang normally intended to frighten the enemy or to panic their mounts on battlefields. The crude tube charged with cruder explosive powders were continued to be used as a secondary weapon for many centuries, quite often with very poor performance. Hence, these early gunpowder weapons were never given much importance, and the bow, sword and spear were considered much superior weapons. In Europe, hand guns and hand cannon remained unpopular for nearly two centuries after their introduction as they failed to complete with the longbow and crossbow on the battlefields. A European observer wrote in the 1600s: "In a skirmish there dieth not so many as one man, for the harquebusiers content themselves with making noyse, and so shoot out all adventure." Fortunately, the Europeans consistently experimented to improve the performance and effectiveness of early firearms, and they ultimately succeeded in replacing the longbow and shortbow with the improved versions of firearms.

It is also a fact that manufacturing techniques of firearms were treated as secrets and so no descriptions of these weapons were given in works of the historic and early medieval periods. Even today, certain manufacturing processes of firearms and ammunition are not fully disclosed by manufactures, although the facilities to patent inventions and innovations provide adequate protection.

Evidently, in their formative stages, comprehensive information about the manufacturing processes of and the working principles of firearms was of importance only to the ruling classes, and so very few copies, normally only one copy, were produced for the specific use of a particular ruler or a prince. Authors of ancient times were basically materialistic in their attitudes. Then, why should a Brahman write a book on any subject unless he was specially ordered to do so by his patron or ruler?

Authors of ancient times were basically materialistic in their attitudes, and so avoided ventures in areas that did not further material gains. Then why should a Brahman write a book on any subjects that would be only of limited requirement.

Artisans like blacksmith and founders who made arms and armor came for the lower rugs of the Hindu cast system. They were invariably illiterate and incapable of recording the constructional or operational aspects of arms they devised. They were also reluctant to disclose such details lest their importance be lost.

Artisans like blacksmiths and founders who made firearms used unfamiliar ingredients. The ingredients have been written in the form of an anagram that was solved only recently. The anagram given in another such recipe is yet to be solved. Another such example is the composition of Greek fire. It was a closely guarded military secret for well over three centuries by the Byzantines. The same was the case with firearms. In England, for instance, the only proof that these firearms were known by 1326 A.D. is on an illumination in a dated treatise (significantly a treatise prepared specially by Milimete as a manual for the guidance of King Richard III) without any description or mention of the weapon in the text of the document.

As already discussed fire weapons and firearms were initially considered unsuitable for warfare and interdicts were laid prohibiting their use on the battlefield. This in turn resulted in the limited number of books composed on firearms, and the few books written on the subject were meant for personal use of some king or prince. It is also a historical fact that in ancient time, numerous foreign visitors of Chinese, Arabian, and other nationalities came to India to learn about scientific, religious and cultural matters and collected all available literature on these subjects. The similarity between some Sanskrit works to those compiled in Chinese and Arabic languages bears ample proof that their main sources were from relevant Indian Sanskrit Works. This would also account for the scarcity of origin Sanskrit works.

This in turn resulted in the limited number of books composed on firearms and the few written on this subject were meant for the personal use of a particular king or prince. It is also a historical fact that from ancient times, many foreign visitors, particularly, the Chinese and Arabs, came to India to learn about matters of scientific, religions and cultural interests, and they collected all literature that they could pertaining to these subjects (which would account for the scarcity of such works in India now). The similarity between some Sanskrit works and those written in Chinese and Arabic languages bears ample proof that the original sources of the latter works are Sanskrit works of Indian origin.

The layout and sequence of verses describing gunpowder and gunpowder weapons in Section IV, Chapter 7, of the *Sukraniti* give the reader an impression that they are placed in a haphazard manner and this is one of the reasons for arms historians to assume that some of these verses are interpolations of a much later period than the original work. However, when these verses are regrouped according to logical sequences it is possible to segregate those verses, which are obviously out of place. Many versions of the *Sukraniti*, translated and edited by various authors are now available and by comparing these versions it is also possible to locate interpolations, if any.

The relevant verses according to Oppert's version of the *Sukraniti* could be regrouped as follows:

Group One – vv. 131 to 133:

(131) whatever is thrown or cast by incantations, machine or fire is a projectile, machine or fire is a projectile, what is different is a weapon like the word, spear, etc. (slashing, hitting and thrusting weapons).

(132) the projectile weapon must be known to be of two kinds, that consisting of tubes and that thrown by incantation.

(133) if there are no incantation weapons a king should always keep tubular arms along with other weapons for the sake of victory.

Combat with weapons (*sastra-yuddham*) in the absence of tubular projectile weapons (*nalastra*). (145) The tubular projectile weapon (*nalastra*) is of either iron or any other metal, rubbed clean and covered by gunners everyday.

Group three – verses 150 and 151:

One should clean the tube (*nalsatram*) first and then put gunpowder (*agnichurnakam*), carry it down with the ramrod to the bottom of the tube (*nala*) till it is tight. (151) then put a good ball, and place gunpowder (*agnichurnakam*) on the vent (*karne*), and by setting fire to the powder at the vent discharge the ball toward its mark.

Group four – verses 135, 136, 137, 138, 139, 140 and 149:

Verse 135: The tubular weapon (*nalikam*) is of two kinds, large (*brhat*) and small (*ksudra*). (136) The tube (*nalam*) is five spans long, the breech has perpendicular and a horizontal hole at the breech and muzzle is always fixed a season bead for aligning the sights. (137) The breech has a mechanism (*yantra*) at the vent which, carrying stone and powder, makes fire by striking. Its breech is well wooded at the side and in the middle is a hole an angula breath. (138) After the gunpowder (*agnichra*) is placed inside, it is firmly pressed down by a ramrod. This is the small gun (*laghunalikam*) which ought to be carried by foot-soldiers. (139) In proportion, its outside (*bark*) is hard, its hole is broad, its ball is long and broad; the ball reaches far. (140) A big tube (*brhannalika*) is called that gun which obtains the direction of the aim by moving the breech with a wedge, its end is without wood, but it is to be drawn on crafts, & c., if well welded it gives victory. (149) By the application of fire they throw ball coming from the tube at the mark. (144) The ball is made of iron and either has small balls inside or is empty; for small tubular arms (*laghunala*) it should be of lead or any other metal.

Verse 161 says: "The fighting with incantation projectile weapons (mantrastra) devine, that with tubes (nala) and other instruments demonic that the weapons (sastra) and the arms of the body are human." Here, the

use of *nala* is looked down upon, whereas according to Verse 266 it is better than fighting with bare hands. These two verses contradict each other.

Group Two: vv. 266 and 268 and 269:

(266) The best fight is with incantation missiles (*mantrastrena*), the middling is with tubular projectile weapons (*nalikastrena*), the lowest with weapons (*sastra*) and the worst is with bare hands (*bahuyuddham*). (268) The throwing of a ball by a tubular instrument through the application of gunpowder (*nalagnichuna*) and a tube (*nalikastra*) is very destructive to the enemy. (269) The destruction of enemy which takes place by means of lances and other weapons (*sastra*) is always to be known as *sastra yudham*.

Edited version of *Sukraniti*, verses 203, 205 and 210 mention *nalastra*, verses 207 and 211 mention *laghunala*, and verses 204, 209 and 211 mention *lohamayagola*, and these verses occur in pages 585 to 557.

The verses in *Sukraniti* describing *agnichrnakamu* (fire powder or the so-called gunpowder) could be rearranged into two distinct groups as follows:

Group one, IV:7: vv. 141 to 143:

Five weight (pala) of saltpeter, one weight of sulfur and one weight of charcoal, which consists of *Calotropis gigantea*, *Euphorbia neriifolia*, and other plants, is prepared in such a manner that the smoke does not escape; if all this is taken after having been cleansed, powdered and mixed together, one should squeeze it with the juice of *Calotropis gigantea*, *Euphorbia neriifolia* and *Allium sativum* and dry in the sun; having ground this like sugar, it will certainly become *agnichurna* (gunpowder). There may be six or even four parts of saltpeter in the *nalstrathagnichurna*: (gunpowder for *nalastra*) but parts of sulfur remains as before.

Group two, IV:7: vv. 146 to 148:

Gunpowder is made in many ways, as well as in white and in other colors and with similar, or greater, or lesser proportion of charcoal, sulfur and saltpeter, of orpiment and likewise of graphite, of vermilion and also of

powder of magnetic iron oxide and of camphor, of lac and indigo and likewise of pine gun (*Pinus longifolia*).

The recipe given in group one is quite similar to that given in the Chinese treatise *Wu Pei Chih*, an encyclopedic compilation on military apparatus published in 1628, but believed to be based on earlier sources. The Chinese recipe of the fire powder (note the similarity of the name fire powder and the *agnichurna* – also meaning fire powder – mentioned in the *Sukraniti* for gunpowder) also contained saltpeter, sulfur and charcoal in the proportion 5:1:1.

The recipe of gunpowder given in group two verses of the *Sukraniti* is also similar to the recipe given in another Chinese treatise *Wu Ching Tsung Yao*, compiled in 1044 A.D., but available only in a fifteenth-century copy. All the three basic ingredients given in both the Chinese and *Sukraniti* recipes are the same and the only difference is that some typical Chinese ingredients are substituted in place of the Indian ingredients. The *Wu Chih Pei* is believed to be composed in 1040 and the original source of *Wu Ching Tsung* is not known. The earliest dateable copies available of the former are of the fifteenth century and of the latter are of the seventeenth century. Thus, the probability that the original source of both these two Chinese treatises was the *Sukraniti*, in which case the *Sukraniti* would be of the eleventh century or earlier.

It is also of interest to note a reference quoted by Peterson[105], which reads: "A German military treatise called the Feuerwarkbuch (firework gun) written about 1420 by an unknown author, describes the materials used in making gunpowder, the methods of making ordinary gunpowder and special gunpowders, incendiary compositions and guns and shooting. It mentions 'white gunpowder,' apparently charcoal was replaced by starch." While gunpowder is also mentioned in the *Sukraniti*, a number of Sanskrit works were examined and translated by German scholars in the past and quite probably this work, *Feuerwarkbuch*, was one of them; hence, the uncertainty of the author's intent. Possibly, the *Feuerwarkbuch* was based on

the *Sukraniti*. It is quite probable that a version of the *Sukraniti* must have been obtained by the Arabs and then in turn passed on to the Europeans. There is also the possibility that the Arabs had obtained the knowledge of gunpowder and early gunpowder weapons from the Chinese, who had already acquainted themselves from Indian sources.

According to Partington[106], who had examined almost all available Chinese sources, gunpowder of a weak nature was known to the Chinese by the beginning of the eleventh century. It was not powerful enough to be used as a propellant and so was used as a weak explosive in the pyrotechnic compiled; long bamboo tubes were filled with explosive powder and were used as offensive weapons.

The Arabs and their tribes, such as the Saracenes and Moors, seem to have transmitted the knowledge about gunpowder and early fire weapons to the western world before the third quarter of the thirteenth century. According to Blackmore[107], this hypothesis is supported by an Arabic manuscript believed to be of the period 1300 to 1350 A.D., of which a fifteenth-century copy was formerly held in the Musse Asiatic in St. Petersburg. The above chronology agrees with the hypothesis that the *Sukraniti* was written earlier than the eleventh century and the Chinese obtained this treatise and learnt about gunpowder and early firearms such as bamboo tubes filled with explosive powder and used them as offensive weapons by the early twelfth century. Then, the Arabs obtained this knowledge from the Chinese and the Moors, a tribe of mixed Arabs and Berbers in the Spanish Wars in the twelfth century. Finally, the Europeans learnt about this from the Spanish by the thirteenth century.

It is not possible to precisely date the *Sukraniti*, as is the case with most other ancient Sanskrit works. However, study of some major contemporaneous Sanskrit works along with those of Chinese and Arabic works helps to arrive at the approximate period when it was compiled. Some negative evidence and indirect evidence derived from other sources may also help in this regard.

Certain maxims mentioned in the *Mahabharata, Harivamsa, Kamandakiya, Manusmriti, Nitiprakasika and Panchatantra* are also found in the *Sukraniti*. The *Kamandakiya*, an ancient Sanskrit work of unimpeachable authenticity and the earliest work mentions (XII: 60) that Manu, in his famous law book suggested that the number of ministers at the court of a king should be 12, Brhaspatya says that the number should be 16, and Usanas fixes it 20. In the *Sukraniti* (II; vv. 69 & 70), the same number of 20 ministers is suggested. The *Kamandakiya* (VIII:22 & 23) credits to Usanas the observation that the sphere round the king should consists of 12 other kings, of whom four are friends, four enemies, and four neutrals. It was already mentioned that Oppert was of the view that according to Hemachandra's *Anekartharatnamala* (II:33 & 34) and Helayudha's *Abhdhanarathamala* (I:48) Usanas and Shukracharya, the author of *Sukraniti* are the same.

7.8 Summary

1 The inclusion of mantramukta class of weapons in the Sukraniti indicates that this work was composed before the Agnipurana (c. eleventh century A.D.) as this classification was dropped by the time Agnipurana was composed.

2 The Nitiprakasika was obviously composed before the Sukraniti as the weapon mentioned in the class of mukta weapon was an incendiary arrow, dart, or ball – shooting tube or flame-throwing machines most probably operated mechanically, as no explosive is mentioned.

3 Manu's law book placed incendiary arrows or darts as an objectionable weapons, and later Nitiprakasika amended this interdict by substituting flame-throwing machines in its place. Thus, the Nitiprakasika was composed after the Manusmriti.

4 The nalika of Kamandakiya was obviously a military pyrotechnic.

5 The orbat suggested in the Sukraniti indicates that firearms had positively made their appearance on the battlefields by this period.

6 The Chinese military treatises, Wu Pei Chih and Wu Tsung Chung Yao, contain descriptions of gunpowder similar to those given in the Sukraniti, and the earliest of the Chinese works are dated to the eleventh century (1040 A.D.), and the Sukraniti was composed before the eleventh century.

7 The Ajanta frescoes do not depict firearms and so the Sukraniti was composed after the sixth century A.D.

8 Firearms are depicted in Indian stone carvings of the period c. thirteenth century, earlier than any other country (England 1326).

9 All the ingredients of gunpowder were known and easily available in India from ancient times. The charcoals of the woods mentioned in Sukraniti are still used in India for making gunpowder and pyrotechny.

10 Both the Chinese and the Arabs had well-established religious and cultural intercourse with Indians from ancient times. The peninsular India had well-established sea routes connecting the coastal regions of this subcontinent with both the eastern and western nations of the world.

11 The coastal regions of peninsular India knew about gunpowder before north India.

The ancient Hindus were also, as is well known, greatly adept in the art of smelting and casting metals. The Rumps hill men dug and smelt iron ore and cast it into musket barrels. The ancient Hindu enjoyed a well-deserved reputation as skillful artisans in iron and steel, and these circumstances go surely far enough to justify that ancient Hindus were as well able to prepare firearms as the modern Indians.

A study of literary sources mentioning coinage of India helps us to at least approximately date ancient Indian works.

In the age of *Dhamasastras*, the gold coin was known as *suvarna* and one gold coin was equal to 80 *krishnalas*. The silver currency consisted of the *krishnalas, masha, dharma and shatamana*. The copper coins were known as *karshapanas*, attributed as Pana and the smallest coin was 1/8 Pana.

The pana (a silver coin of about a shilling) was the standard coin in the period of Kautilya's *Arthashastra*. The currency in the Deccan during the

Satavahana period consisted of *karshapanas*, which were both silver and copper. *Suvarna*, a gold coin, was equal to 35 silver *karshapanas*. One *karshapana* weighed 146.4 grains and one *rathi* was equal to 1.83 grains.

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[103] M.S.No.409 of 1882–1883, Government MSS Library, at B.O.R. Institute Pune, Folio 10. Quoted earlier by P.K. Gode.

[104] Talboys Wheeler, T. *History of India*.

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[107] Blackmore HL Guns and Rifles of the world, London 1965.

Chapter 8
Fire Weapons: Early Medieval Period

In India, the early medieval period is considered from 700 A.D. to 1300 A.D., and for scholars examining evidence about the origins gunpowder and firearms the last two centuries of the are the crucial. Authentic sources mentioning both fire weapons and firearms are very rare, and, therefore, scholars examining the early trends of development of fire weapons have to rely mainly on indirect evidence, such as painting, sculptures, and inscriptions.

On the question of whether or not the Indians knew about pyrotechnic, or fire weapons, or proto-firearms in the early medieval period, neither many studies nor serious research has been conducted. The few scholars who tried to trace back the history of development of Indian firearms, unfortunately, greatly relied on some ancient manuscripts, or translations thereof. These sources could neither be dated nor authenticated, mainly due to nonavailability of their originals. As the present consensus is that the Chinese used pyrotechnics weapons by the mid-twelfth century, scholars seeking evidence to establish that the Indians knew about them before the Chinese should concentrate their efforts on sources that could be dateable to the period, about a century or two, before the mid-twelfth century A.D.

Perhaps, it would also be of use to have a glimpse of the historical background of India to get a correct perspective of the contemporaneous marital status of the country. Attention of the early medieval foreign traders, invaders, and raiders was drawn toward India mainly due to the wealth and prosperity of the country, and the large scope for profitable trade and commerce. As mentioned earlier, India was well connected by both sea and

overland trade routes. The former was in use from ancient times and were the main arteries of trade and commerce, particularly for the coastal regions of India. The overland routes were established later and were not negotiable in the winter months when the mountain passes became snow bound.

The overland routes connected the northern regions of India with Central Asia and China and were used not only by the traders but also by the invaders and raiders of north India from prehistoric times. However, it appears that there were hardly any trading or other relations between the northern regions and the southern regions of India before the period of the Deccan Sultan, thirteenth century. Perhaps this was mainly due to the poor overland routes connecting these two regions.

Arabian report informs that the Arabs in India used *atish-bazi* similar to those used by the Greeks and Persians. The Arab victories in Sind and Multan paved the way for the Turks and Tartars[108] to conquer Delhi. For these invaders, India was what Indies was to the poverty-stricken gentlemen of Spain. The Turkish kingdom was founded in 933 A.D. Alaptagan, whose grandson was Mahmud, succeeded his father Shukuktgan in 997 to the throne of Ghazni. The Torko Afghans, under the leadership of Mahmud Ghazni invaded India in 1001 and defeated the Hindu king Jayapala near Peshwar. In the succeeding 24 years, Ghazni carried out 16 more expeditions to India. One of these was against Anandapala, the son of Jayapala, in 1008. Brigges[109] mentions that in the battle against Anandapala, Mahmud Ghazni ordered 6,000 archers to the front who were opposed by the Gakhars[110]. All of a sudden the elephants of Anandapala fled away hearing the noise of *naft* arrows. They were of two types, the ones used by Bin Kasim were incendiaries and those used by Ghazni were noise makers.

Farista tells us about this (1008) cannons (Top) and muskets (tufang) that were used by Mahmud (see the History of India, ed. Sir H.M. Elliots papers by Prof. J. Dawson Vol. IV, pp. 219 & 454).

From c. 1030, India remained almost free of raids from the northwest, until Mohammad Ghori attacked in 1191. Naturally, during this long spell of peace, lasting well over a century, Indian history chronicles are secretive about warfare and we do not find any descriptions of arms or weapons during this crucial period in the history of development of gunpowder and firearms.

Ghor was a small state in Afghanistan which was initially under Ghazni. In 1173, a prince of Ghor captured Ghazni and Shahab-ud-din or Mu'izz-ud-din,generally known as Mohammad Ghori and succeeded as the chieftaincy of Afghanistan and became the Governor of Ghazni.

Mohammad Ghori conquered Multan in 1175 and in 1186 he imprisoned the last of the Ghaznavites. In 1191, he marched toward Delhi and was met by Prithviraj Chauhan, the Rajput ruler of Delhi. Prithviraj went forth along to meet the invaders at Tarain (also known as Tara Wari, north of Karnal), on the great plains near Delhi. Prithvi Raj sent an arrow through Muhammad Ghori's right arm, and the Turk fainted with loss of blood and fled. His army also followed suit and was pushed by the exulting Rajputs for nearly sixty kilometers to the front.

The Baan – Please see under Fire Weapons: Late Medieval Period 1300–1700 A.D.

The Chakry – Please see under Fire Weapons: Late Medieval Period 1300–1700 A.D.

The Roman Candle – Please see under European Fire Weapons

The Espingnolle – Please see under European Fire Weapons

This was a European fire weapon working on the Roman candle principle – that is, it used superimposed loads. The barrel, invariably an iron tube, was loaded alternately with charges of powder and ball. Each bullet had a longitudinal channel, normally a hole drilled right through it to permit the flash produced by the burning charge powder above it. Once charge has

been fired, the rest of the charges went off one after the other until the barrel was empty.

Porta[111] described another version of fire weapon (a great brass-gun!) also working on the Roman candle principle. "First put in a certain measure of Gunpowder, that being put in, may discharge the Ball, but a small one, that it may go in loosely, and the powder put in upon it may come to touch the gunpowder; then pour in the dark powder[112] two or three fingers depth; then put in your gunpowder, and your bullet; and thus in order, one after the other, until the gun seems to be full to the very mouth."

The other two military operations are in the reign of Jalal-ud-din Khilji (1290–1296) when he sent his nephew Alia-ud-din to attack Devagiri (now Daulatabas), where he defeated Ramachandra Deva. And the other, in the reign or Alla-ud-din Khilji (1296–1316) when he attacked Ranathambhore and then proceeded to attack the Chittor fort, in quest of the famous beauty queen Padmini.

Pant[113] writes that according to Akram Makhome[114], *khusk anjeer*, literally meaning dry figs, of the time Iltutmish was a machine that threw stones. Pet Anwari also mentions it was a weapon used in siege and according to Bahar-I-Azam it was an instrument that worked with gunpowder. This fact is corroborated by another manuscript, Adaa-ul-Harab by Shajaat Fakhr-i-Mulabir also (A.M. Journal op. cit.). The *manjaniq* was also a siege craft which was hurled at enemy forts with great force. *Sang-i-maghrabi*, also known as *misfe and manjaniq*, is mentioned by Zia-ud-din Barni[115]. Farista[116] also calls it *manjinique* and Maulana Abu Zafar[117] distinguishes it as *Hindustani top*. A paper published in an Urdu monthly magazine of December Maarif of December 1949, reads:

"sang-i-maghrabi was invented in the sixth century Hijri (c. twelfth century A.D.) and end of the seventh century Hijri and beginning of the Eight century Hijri it was popular in Spain and Africa, and these countries

were called Maghrabi, meaning Western, by the Arabs, and hence the name. However, these types of siege craft were called *midfa* in Arabic."

Kautilya[118] (c. 300 B.C.) is one of the earliest writers on military tactics and weapons, systematically describing every type of contemporaneous arms and armor. Pant[119], quoting the work of Kautilya, mentions weapons, such as *sarvato-bhadra mahasara-yanta, bahumukha* (many faced), *parayanka, jamadaagneya,* and so on. Kautilya mentions many methods to assault enemy fortifications. Says he: "With the help of artificial staircase (obviously scaling ladders) at attempts should be made to reach the parapet, and if strongly protected, machines, explosives and other material should be used to bring down the wall."

From the *Arthashastra* it is evident that forts were considered as highly defended localities and give detailed instructions for their ideal layouts, defenses, and methods of assaulting and destroying enemy forts. In this work, Kautilya speaks of arrows spitting fire used for setting fire to enemy defenses and building. However, as no detailed descriptions of the weapons mentioned above are given in the *Arthashastra* it can only be presumed that the weapons mentioned are large fire weapons meant for destroying enemy forts, and incidentally to defend own fortifications from enemy assaults, that is mechanically operated siege machine possibly some of them discharging incendiary missiles. Kautilya does not mention either gunpowder or firearms (*nalastra*). It is quite unlikely that this unusual man who was well versed on strategies of warfare and application of various types of weapon could have failed to mention firearms if they existed in his time. Another contemporary of Kautilya, Magasthanese, and the Greek ambassador at the court of Chandragupta (c. 300 B.C.) also does not mention about the usage of firearms in his accounts about India in the Mauryan period. However, Pant[120] states that the weapons mentioned by Kautilya in his *Arthashastra* are probably missiles rather than firearms.

The much quoted Sanskrit work *Sukraniti*[121] believed to be written by Shukracharya, and assigned by scholars to the Gupta Period (c. fifth and

sixth centuries A.D.), is another important work about weapons of the period. It prescribes guns and projectile weapons as standard equipment for king's war chariot. It also mentions a weapon *nalastra*, literally a tube weapon, which is believed to be a firearm by the Indian protagonist.

Sulfur is found in India, especially in Sind (now in Pakistan) and it was one of the commodities imported from India from the east – the volcanic regions and islands in the pacific. In Sanskrit, it is known as *Gundhaka* or *Gandha* for its not so pleasant smell. The ancient Indians refined it by boiling crude sulfur with castor oil or goat's milk. Refined sulfur has been used as a medicine, particularly for skin diseases since time immemorial.

Charcoal, the third ingredient of gunpowder, is derived from different plants and in Europe the coal of willow and hazel are the favorites. In the recipes given in *Sukraniti,* the Arka (*Calotropis gigantea*), the *snuhi shrub* (*Euphorbia neriifolia*), and Rasona (*Allium sativum*) are mentioned as best plants of which charcoal should be made for gunpowder.

The *arka* or (akha) plant *aruka* in Telugu and *arukul jilledu* in Malayalam and *akund* in Bengali was known in north India and was used extensively since times in memorial and as additive to convert iron ore into the world famous Indian steel of the medieval period. The sap, a milky white juice, which flows out of the plant when the leaf or stem is broken, and its roots were used as medicine for various diseases, including syphilis. Its charcoal particularly from its roots was invariably used in pyrotechnics and gunpowder because of its excellence. The snuhi (triangular sponge *kalli* in Malayalam, *pasan kalli* in Tamil, *bontajammdu* in Telegu, *narashry* or *seyard* in Hindustani and *narsey* in Bengali) grows like *arka* in waste places all over the Indian peninsula. Its charcoal was also used extensively in pyrotechnics and medicines. The Rasona is a kind of garlic and its central stem barring the flower makes fine-quality charcoal powder. The ancient recipes for pyrotechnics powders and gunpowder also mention a mixture of different kinds of charcoal mentioned above.

8.1 The Indian Chronicles

True Firearms

Manuscripts and books mentioning true firearms of the thirteenth and fourteenth centuries, which is the crucial period in the history of development of firearms are extremely rare and their subsequent transcriptions cannot always be depended upon for accuracy and subsequent interpolations. It is also difficult to date them with reasonable certainty.

As in the case of many other countries, original works pertaining to this period are not available, and their copies, or later transcriptions, dating before the fourteenth century and mentioning Sanskrit equivalents of true firearms are extremely rare. Only subsequent transcriptions, reproductions, edited versions, and translations thereof, invariably published after fifteenth century could be located with difficulty.

It is now generally supposed that Rogger Bacon learnt the secret of manufacture of gunpowder while he was traveling in Spain, where he was pretty well known among the Moors, who were not only the most learned nation at that period, but who through religious and national trading were intimately connected with compatriots. An Arab treatise on gunpowder written in 1249 is upto this day preserved in the library of the Royal Escurial.

In the national library at Paris a work ascribed to one Marcus Graecus is preserved. It is published in Paris as *Liber ignium ad comburendos hostes anclore Marco Graeco*. According to some he lived in the ninth century and according to others in the thirteenth century. Even the accuracy of the name is doubtful as he is also called Marcus Graechus instead of Graecus. If the latter appellation is more correct, it may perhaps be surmised that the work was originally written in Greek. Saltpeter appears three times in his book, as *sal petrosum, lopis qui dictur Petra salis, and as sal petrom.* According to

Marcus Graecus, the composition of gunpowder is two parts of charcoal, one part of sulfur and six parts of saltpeter.

From the end of the sixteenth century onward (after true firearms were definitely known and in use in many parts of the world countries), the words *nalika* and *nal* started appearing with gradually increasing frequency in some Sanskrit and other Indian language works. There terms are, however, invariably combined with other words or terms. For example, the word *nalika* is usually prefixed with terms like *suthalanibha, kalambhudhi* (lighted with a wick), *laghu* (light), *shatha-shathardhi* (hundred-fifty), *mushtra*, *ustra*, and so on. The term *nal* is prefixed by the terms *gaja* (elephant), *phili* (elephant), *sutar* (camel), *haya* (horse), and so on. It could also be seen that along with the above Sanskrit terms, a few words of foreign languages, such as top (cannon) and bunduk (musket) are used in some Indian chronicles from the sixteenth century onward. These new words appear with gradually increasing frequency from the sixteenth to seventeenth centuries and ultimately displaced the Sanskrit words by about the eighteenth century.

India is a vast subcontinent in which, apart from Sanskrit, many regional languages, some with their own scripts were used in the medieval period. Languages such as Telugu, Tamil, Kannada, and Malayalam were in use in India well before Sanskrit was introduced by the Aryans. These languages had very little in common, either in the script alphabets or vocabulary, with Sanskrit. Thus, the Indian languages are known by several names, depending on the language used. For instance, the gun was known as *nalikastra* in Sanskrit, *bunduk* in Hindu, and Urdu, toku in Malayalam (*peerangi for cannon*), *tupaki* in Telugu (*pirangi for cannon*). It is noteworthy that a gun (musket) was also known as *tupak* in Turki, which is very similar to its equivalent in Telugu tupaki. Did the Arabs adopt the gun from the south Indian, or it is the other way around? Scholars are still to examine this aspect. It is also strange that the word *firangi* in Hindi means a foreigner, such an English, Portuguese, French, and Dutch. Whereas pirangi in Telugu, Malayalam, and Tamil means a cannon. There is thus a probability that due

to association of ideas the word pirangi (cannon) was associated with foreigners – *firangees*.

On the question of whether or not the Indian knew about firearms in the early medieval period, not many studies have been conducted and exhaustive research has not been done. The few scholars who have tried, unfortunately, greatly relied on some ancient manuscripts, or translations thereof, of which no original texts are now available and they could not be dated with authentically. Naturally, the present consensus is that there is no positive evidence to prove that true firearms were known to the Indians before the Chinese or the Europeans, that is, before the fourteenth century.

Fortunately, the late medieval Indian sources provide more reliable information about weapons in general, and firearms in particular compared to the earlier period. Perhaps one of the reasons for this is that the standard of education was rising and spreading rapidly not only among the Brahmin community but also among the laymen. It is, therefore, not very surprising that the best available references about true firearms are available from sources of this period.

It is also a fact that the Mughal royalty nobility was invariably good scholars and keen sportsmen, unlike the Brahmins of the earlier period. Naturally, the accounts of the Mughal this period contain more detailed descriptions of weapons and their application both for and sport. Perhaps, such accounts led some early scholars to believe that firearms were introduced by the Mughals, in the early part of the sixteenth century, after the invasion of Babar.

According to Farishta, Halaku Khan, the founder of the Mongol Empire in Western Asia, sent in 1259, an ambassador to the king of Delhi, and when the ambassador was approaching he was received by the Wazir of the king with a great retinue and among the splendid sights was 3,000 fire carts.

Timurlane, the descendant of Genghis Khan, left his capital Samarkhand in Central Asia with a big army, crossed Punjab, and marched southward to

conquer Delhi. He came face to face with the Delhi Sultans and occupied Delhi in 1398 A.D. Some historians are of the view that he was a great admirer of firearms and used several gunsmiths to manufacture them; he used them in his invasion of Delhi. Perhaps, there is little to doubt these firearms were already known and used in China and Europe by this date, and Timur being a descendant of the Great Khan Genghis Khan, and the Mongols learnt about gunpowder and guns from the Chinese. Whereas the Indian sources already mentioned state that Timur had to face pyrotechnic, or fire weapons, of the Indians.

According to D'yezd[122], in the battle near Delhi fought between Tamur lane and Sultan Mahmud, the latter opposed his enemy with 10,000 horses, 40,000 men on foot, and a great number of elephants, clad in mail armor. On top of these elephants there were big howdahs from which the sharp shooters flung fireworks and rockets at the troops of Timur, and on the size of these elephants marched "des jelleers de pots a feu et de poix enflame sinsi que des fuses volantes ponitees de fer, qui domint plusieurs coups de suite dans le lier on'ts tombent" (History de Timur-bec, par Cherifeddin Ali d'yezd, tradnite par le fuw M Pelits de la Croux 1723, III, p. 94). According to Clavigo[123], Timur was beaten in the first engagement through 50 mailed elephants, but on the following day Timur took many camels and loaded them with dry grass placing them in front of the elephants when the battle began. He caused the grass to be set on fire and when the elephants saw the burning straw upon the camels they fled (narrative of the Embassy of Ray Gonzalez de Clavijo to the court of Timur at Samarkand. London, 1859 page 153). When attacking Bhatnir, Timur's troops were received in a similar manner for "the besieged cast down in showers of arrows and stones and fireworks upon the heads of the assailants." (Malfuzal-i-Timuri, in Sir H.M. Elliots histories of India, III, 424).

Babar (Zahir-ud-din-Mohammad) of Kabul was a ruler of a small state called Fargana, in Central Asia. He invaded India first in 1509 A.D. well over a century after Timur. He had mastered successfully military tactics of the

Uzbegs, Afghans, Mongols, and Persians of Central Asia before he invaded India, and already familiar with firearms. He had at his disposal services of efficient cannon founders Ustad Ali Khan Kuli and Mustapha. Erskine[124] mentions that on November first, 1526, Babar witnessed the casting of cannon by Ustad Ali at Agra.

During the second wave of invasion, Babar entered through the Nor-West boarders of India and fought a great battle of April 21, 1526, against Ibrahim Lodi, the Sultan of Delhi. Many historians are of the view that Barbar's main military strength was his artillery and superior tactics.

It is believed that the First Battle of Panipat led to the introduction of artillery as an essential arm of the Indian fighting forces. One of the historians go to the extent of stating: "Hither to Indians were not conversant with the usage of gunpowder much less with that of artillery. It was the Mughals who by making use of guns and gunpowder in the First Battle of Panipat not only won the battle but also brought the artillery into their lands." According to another historian William[125], "If there was any single factor more than any that conducted to the ultimate triumph (of Babar) it was the powerful artillery, While Ibrahim Lodi had no guns and gunpowder, Babar had a powerful artillery consisting of big guns and muskets."

Another account of the Battle of Panipat is given very vividly by another historian: "Babar took up his position which was highly favorable. The right of the fortress was to be protected by the town of Panipat, in the center were placed cannons, and the left wing was strengthened by digging a ditch and constructing an abates. 630 gun carts were fastened together with raw hides. In between the wagons carts were left gaps to enable the horsemen to charge abreast. Behind each pair of wagons was raised a small raised a small raised brickwork to provide shelter to gunners and the artillery was fused up there." This narrative highlights the superior military tactics adopted by Babar.

In Babar Nama, the memoirs of Babar translated by Irvine mentions about the casting of a cannon at Agra, and supervised by Quli Khan. Ray[126], quoting Meclagan[127] says: "The first recoded use of cannon and gunpowder in Indian warfare is in the memoirs of Babar. In 1528 he forced the passage of the Ganges near Kanuj with the aid of artillery. In this naval battle he seized forty naval vessels."

Third, it was difficult to penetrate medieval plate armor before the introduction of firearms. The invention of firearms rendered medieval plate armor useless and cavalry ceased to be a dominant arm. In India soon after the adaptation of fire weapons, the war chariot became redundant as it provided an easy target and the horses drawing it panicked when guns fired. Last, although early hand firearms are very inaccurate and probably unreliable as they positively contributed to the downfall of the armor-clad knight. Soon after the adaptation of the musket by the infantry, the horse-mounted and armor-clad knight vanished from the continental battlefield as he could neither use the musket from horseback nor could protect himself from the lethal bullets of a musketeer with his plate armor only after the introduction of the pistol and carbine for military use the equestrian combatant, armed with a pair of flintlock pistols at the saddle bow, dared to enter the field once again to face the musketeer.

When we examine the Indian sources for such telltale evidence no such conspicuous changes could be detected until about the end of the Mughal period, excepting that elephants were relegated to the rear echelons and were used mainly for transporting cannons soon after the introduction of firearms for military use.

Pant[128], quoting Shrivastava[129], states that cavalry was the most valued wing and the backbone of the Indian military system in medieval India. Each horseman was armed with two swords, a dagger, and a box.

Fire Weapons: Late Medieval Period – 1300 to 1700 A.D.

Indian chronicles are more abundant with reliable information about weapons in general, compared to the earlier period. The standard of education was rising and spreading rapidly, not only among the Brahmins but also among laymen. The Mughal royalty and nobility were invariably good scholars and keen sportsmen, unlike the Brahmins. The chronicles of this period provide naturally more detailed description of weapons and their applications on the battlefields and sports. It is therefore not very surprising that the best available references about fire weapons and firearms could be found on these accounts chronicles. Perhaps, such frequent references led some early scholars to believe that these weapons were introduced by the Mughals. However, ambiguity in the meaning of the words used for pyrotechnic or fire weapons, proto-firearms, and true firearms continues to bother scholars examining sources of this period. All these types of weapons were used throughout this period and anachronisms are very common, which complicates that issue further.

8.2 The *Baan*

The *Baan*, a primitive rocket, was perhaps one of the earliest fireworks which was modified successfully as a military pyrotechnic. Gode[130] mentioned some essential ingredient using the manufacturer of fireworks; *sulfur (gandhaka), saltpeter (yavakshara), charcoal (angara), steel and iron powder (filings), (tikshna loha churna and loha churna), copper carbonate (jangala), yellow or piment (talakam or harital), ochre (gairika), wood of "khadire" tree (khadiram daroo), hollow bamboo piece (nalika), wick (bartika), five salts (pancha kshara), loadstone (akhupasham), pulp of castor seeds (asandamajja), mercury (sutam), rice paste (anna pista) tin or lead (naga), charcoal from "arka" (Calatropis gigantea), wood (arkanagara), cows urine (go mutra), and cinnabar (vermilion*).

He was also of the view that some recipes of pyrotechnics might have been brought from China, for fireworks and military pyrotechnics and were developed much earlier than in any other country. Among the variety of fireworks, the *gola, patka, vengagvedi, koroo, adirvedi* are mentioned in

Sanskrit sources. Chinese fire mixtures used in India and burnt in an earthenware pot are known as *chandrajyoti* (moon light), *mehrab*, or more commonly *anar* (pomegranate). Rockets were known as *hawai* or *abusavanani* and called *bana* in Sanskrit works.

Gode also quotes formulations for the manufacture of specific fireworks from the Sanskrit work called the *Kantuka Chintamani* by Gajapati Pratapa Mudradeva of Orissa, who flourished during 1497 to 1539 A.D. The other work sighted by him is a Sanskrit treatise *Akasa Bhairava Kalpa* (a MS in the Tanjore MS library) which according to him belongs to a period latter than fourteenth century.

For military purposes, as in the case of *naft* arrows *baans* were also of two types: one type exploded with a loud report while the other burst into flames and set fire to the target.

The simplest version of the *baan* consisted of a bamboo tube, about30 cm. long and 8 cm. in diameter. It was filled with an inflammable powder, proto-gunpowder along with a fuse to ignite the powder, and was then closed at both ends with mud or wooded plugs. This tube was attached to one end of a bamboo staff. To launch this missile, the fuse was set alight and the missile was cast by hand, as a javelin, into the enemy ranks where the charge exploded with a loud report.

The effective range and accuracy of such a handcast *baan* depended mainly on the physical ability and skill of the *baan*-thrower. To increase its effectiveness it was subsequently modified to be launched by means of a bow or a catapult.

Another version of the *baan*, mentioned by Rahman[131], works on the actual rocket principle. A special progressively combustible charge was loaded in the tube, by now of metal, and was ignited to produce a stream of powder gases and flames through the rear end of the tube (here only the forward end of the tube was closed) and propelled the entire missile for war. Great skill was needed to launch this type of *baan* as there was always the

possibility of its straying away from its course and landing among own troops.

Moor[132], quoting from Major Dirom's Glossary, writing about the siege of Dharwas (1794 A.D.) states: "Rocket: a missile weapon consisting of an iron tube about a foot and an inch in diameter, fixed to a bamboo rod ten to fifteen feet long. The tube being combustible combustion (note, not with gunpowder) is set fire to, and being directed by hand, files like an arrow to a distance of about a thousand yards. Some of the rockets have a chamber and burst like a shell; other called ground rockets have a serpentine motion and striking the ground rise again and bound along till their force be spent. The rocket makes a great noise and exceedingly annoy the native cavalry in India, who move in great bodies; but are easily avoided, or seldom takes effect, among own troops, who are formed in line of great extent and no great depth." Bernier[133] also refers to *baans* and states that were used in battles between Dara Sikhon and Aurangzeb in 1658 A.D., for frightening horses.

8.3 The Charka, Charky or Chakra

The charky was also used in India as a firework but it was modified later as a fire-weapon and Kalidasa[134]

Mentions it as early as the Sixth century AD. This weapon is often mistaken by some early historians and chronicles for a type of rotating wheel, resembling the Sudarshan Chakra, a weapon of the Hindu deity, Lord Vishnu.; Whereas, the actual weapon consisted of long wooden or bamboo staff with a cross-piece pivoted at each end. Two containers filed with suitable progressive burning powder were fitted to the cross-piece. When these charges were set alight the powder flared and discharged hot gasses and flames through the apertures in the containers. These apertures were were set in such a manner that the forward forces generated by escaping gasses rotated the cross-piece rapidly, and two rings of swirling flames formed at the end of the staff.

The *charka* was an ideal weapon for frightening elephants of the enemy forces as these animals dreaded fire. For this reason, elephants have been used with very little advantage in warfare since the introduction of fire weapons.

Both the hook and the *chakra* are illustrated in a sixteenth-century painting[135], depicting a battle scene. In this painting, the *chakra* bearer pinned down by the tusks of a frightened elephant, presumably while he was trying to scare it away, with flaring charka (Fig. 4.9(a)). A hooka is also shown with stream of flames and gases gushing out of its sprout. A mutilated cavalier could also be seen with his body split in half and one of the pieces flung next to his dead horse. It is apparent that both the cavalier and his mount were killed by the hooka.

8.4 The Gaj-Kundi or Dhamaka

The *gaj-kundi*, also known as *dhamaka* in central India, is yet another instance where a firework was modified for me as a fire weapon. The natural trends of development of fire weapons were twofold: first, to produce stronger explosive powders which could propel missile on explosive and penetrate targets; and second, to make the projectors of such missiles with metals. Perhaps, the only stage that differentiated these weapons from true firearms was the development of true gunpowder and its use as a propellant. In the absence of any other nomenclature for such forerunners of true firearms they can be termed proto-firearms.

It is generally believed that the Chinese were using proto-firearms by the twelfth century and they obtained the knowledge about these weapons from them and transmitted it to Europe. However, it is rather surprising that the Indian who had established close contacts with the Chinese much earlier failed to mention about them before the Arabs. Hence, the probability that the Indians knew about proto-gunpowder and proto-firearms and this knowledge reached both China and Central Europe appears to be a more plausible. The hypothesis, however, needs a more detailed examination.

However, once the explosive properties of proto-gunpowder were known reinforced bamboo tubes (*nalika*) were first used for proto-firearms. A quantity of this powder was poured down the tube, which was blocked at one end, and a missile, such as a small arrow, round pebble, or clay pellet, was rammed after it. When the powder was ignited and exploded it ejected the missile out of the open end of the tube.

When such forerunners of true firearms were first made and used in India is unclear. Their existence seems to have been known by the beginning of the early medieval period, since some terms which could now be translated to mean tube weapons, are mentioned in some Sanskrit works from the end of the fifteenth century – if not earlier. Although the bow, sword, and spear were still in use up to the seventeenth century, firearms were beginning to enter the military scene; powder and lead were displacing steel.

Tubular–copper arrow–firing weapons are mentioned by Abul Fazl[136](c. 1590). It was known as *novak*, and consisted of a copper tube through which arrows were shot with an exploding charge of gunpowder. In the Persian to English dictionary, Steingass[137] says that *nao* was a small arrow for shooting from metal tubes.

[108] A member of a group of people including Turks, extending to the Mongols, Turks and other warriors, who swept over Asia and Europe.

[109] Brigges, J. *Tarikh-i-Farista*, tr. Vol-I. London, 1870–1872, pp. 46–47. Quoted earlier by Pant, G.N.

[110] A race of mountaineers living at the foot of Shivalik Renges and spread up to the Punjab of the undivided India.

[111] Porta. *Natural Magick*. English edition of 1658, quoted earlier by Blackmore, op. cit.,p. 77.

[112] This was a rocket mixture composed of turpentine-rosin, liquid pitch, varnish, frankincense and camphor, equal parts, quick brimstone a third part and half; two parts of saltpeter refined; three parts of aqua fortis as much of Oyl of Peter and gunpowder.

[113] Pant, G.N. *Studies in Indian Weapons and Warfare*. Delhi, 1970, p. 244.

[114] Makhdhum, A. *Journal of Indian History*, Vol-XV, Pt. I, pp. 185–187.

[115] Zia-ud-Varni, Tarikh Firozshahi.

[116] Farista. *History of India*. From Sir H.M. Elliot's papers by Prof. J. Dawson, Vol-IV, pp. 209 and 454.

[117] Maulana Abu Zafar. Paper published in an Urdu monthly magazine. *Maarif*, Dec 1949.

[118] Kautilya. *Arthashastra*. Vachaspati Gairola, 1962.

[119] Pant, G.N., op. cit., p. 216.

[120] Pant, G.N., op. cit., p. 216.

[121] Vidyasagara, J. *Shukraniti, The Elements of Polity*. Vol-I, Calcutta, 1902, pp. 95–103.

[122] Oppert, G. on the weapons. *Army Organizations and Political Maxims of The Ancient Hindus*. With special reference to *Gunpowder and Firearms*. Madras and London, 1880, p. 51.

[123] *Narrative of the Embassy of Ray Goraler de*. Erskine. *Memoirs of Babar,* tr. London, 1826, pp. 343–344.

[124] Erskine. *Memoirs of Babar,* tr. London, 1826, pp. 343–344.

[125] Williams. *Early Asiatic Fire Weapons*.

[126] Ray, P.C., op. cit. Maclegan, P. *Journal of the Asiatic Society*, Bengal, Vol-XLV, p. 33 ff. *Early Asiatic Fire Weapons*.

[127] Maclegan, P. *Journal of the Asiatic Society*, Bengal, Vol-XLV, p. 33 ff. *Early Asiatic Fire Weapons*.

[128] Pant, G.N., op. cit., p. 75.

[129] Srivastava, A. *The Sultanate of Delhi*. 1953, p. 331.

[130] Gode, P.K. *History of Firearms in India.*

[131] Syed Sabahuddin Abdur Rahman, op. cit., p. 49.

[132] Moor, A. *A Narrative of Contain Little's Detachment*. p. 509.

[133] Bernier, F. *Travels in the Mughal Empire*. London, 1891, pp. 74 and 157.

[134] Kalidasa. *Raghuvamsa, VII*, 46; quoted earlier by Pant, G.N., op. cit. p. 146.

[135] A painting (miniature) of a battle scene, Mughal, early sixteenth century in the collection of the National Museum, Delhi, reproduced earlier by Pant, G.N., op. cit., plate XV, opp. p. 112.

[136] Abul Fazl. *Ain-i-Akbari*. Gladwin's tr., Vol-I, Calcutta, 1897. pp. 91–95.

[137] Steingass. *Persian to English Dictionary*.

Chapter 9
Proto-Firearms

Bootes[138] reproduced an arrow-shooting weapon from the Korean book, *The Five Ceremonies*, published in 1474, along with a photograph of a wooden arrow, about three meters long, tripped with iron and feathered (Fig. 5.1(a)). Blackmore[139] also reproduced a drawing of an arrow-firing midfa, from the reputed fourteenth-century Arabic manuscript, mentioned earlier by Oscar Guttmann[140].

The much quoted Chinese treatises *Wu Tsung Chung Yao and Wu Pei Chih* mention numerous proto-firearms. These sources indicate that the Chinese, by c. 1259 A.D. We are using reinforced pieces of bamboo from which balls of clay, fragments of stone, and other solids were expelled by a charge of work explosive (proto-gunpowder) – half-way between a gun and firecracker. According to the *Cambridge Medieval History*, the Mongols led by Batu Khan brought with them firearms (undoubtedly proto-firearms). Although knowledge about firearms reached Europe by the first quarter of the fourteenth century, the exact details of the transmission are still obscure.

9.1 Prototypes of Indian Firearms

The question whether or not the *nal, nalika, nalike or nalam, nalastram* are true firearms in the modern sense of the word is not yet agreed upon by modern arms historians. For the purpose of this article, let us presume that there were prototypes of firearms and examine the Indian evidence pertaining to them.

The word *nalika* and its modification appear to be derived from the word *nala* (or *nalas*), meaning a reed or a piece of hollow bamboo or a hollow tube of metal or other substance. The word *nal* in Hindi means a hollow reed, belonging to the family of bamboo but resembling more the cane (rattan) having a hollow center. It grows in the marshy areas, such as jheels, along the banks of major Indian Rivers. The name *nalika* was given to the proto-gun which was understandably made out of hollow bamboo and fired a charge of proto-gunpowder of a weak nature.

The *Kamandakiya*, one of the earlier works on *Nitisastra* of undoubted authenticity dated to twelfth century A.D., appears to be the oldest Sanskrit work mentioning the word *nalika*; it says that, "Confidential agents keeping near the king should rouse him by strategizing gun-firing and other means as…" Perhaps, here the *nalika* is only a noise maker.

Gode, citing Aravamuthan[141], states: "A Milanese gunner who died in Lahore in 1597, left all his books to the father (Jesuit) – of the mission to the Mogul country – including some technical works on the founding of the cannon and on siege – operations." He also quotes Abul Fazl[142] (c. 1598) about artillery of Emperor Akbar: "some pieces of cannon are so large as to carry a ball of twelfth maunds (about 500 kg), and others required each several elephant and a thousand bullocks for their transportation."

Numerous other references are quoted by Gode of various types of firearms, known by different names, from the seventh-century sources. For instance, Hari-Kavi[143], alias Bhanubhatta (1685 A.D.) mentioned weapons such as *suthal-nibha-nalika* and *bahula-nalika*, probably meaning and multibarreled tubes, respectively. The verse also mentions *sugolikatati* (of cannon balls), the weapon could also be cannon.

Yet another sixteenth-century reference to firearms, quoted by Gode, is a Sanskrit poem by Rudra-Kavi[144] which reads:

"Shitsharairup lairath-nalika vinihata jwaladai sugolikai

Milit yorubhayorath sainiyu paravarthe sanmarasthi-mulastiyo."

The terms mentioned in the above verse are translated by Gode to mean; *ayasagolika* – iron cannon balls; *nalikavinihit* – gun was charged; *sitasarai-sharp arrows*; and *upalai* – stones or gravel.

A further reference to firearms is found in the work called *Askashabhairava-tantra*[145], which appears to be composed during the prosperous days of the Vijayanagara Empire, most probably before 1550 A.D. In the sixtieth chapter of this encyclopedic work, the king is advised to worship thirty-two weapons on a particular day. Among these weapons *nalikastram* is mentioned as serial 23.

While examining the seventeenth-century sources, it is evident that the terminology applied to firearm started changing gradually as the century progressed and the influence of Persian or Arabic words being used instead. For Raghunatha Panditha[146] writes:

"The terms barkhandaj, bunduc (musket), toph (cannon), daroo (gunpowder), jabjung, jamboora, and so on, start appearing in Indian chronicles in some Sanskrit as well as works of other Indian languages."

[138] Bootes, J.L. *Korea Weapons and Armour*, tr. Korean Branch, Royal Asiatic Society Seoul, Vol-XXIII, pt. 2., 1934.

[139] Blackmore, H.L. *Guns and Rifles of the World*. London, 1965, p. 2.

[140] Guttmann, O. *Monuments Pulvoris Pyriti*. London, 1916, fig. 70.

[141] Aravamuthan, T.G. Catalogue of Venetian coins in Government Museum Madras, 1938, p. 22.

[142] Abul Fazl. *Ain-i-Akbari*, tr. Gladwin, Vol-III.

[143] Hari-Kavi alias Bhanubhatta. *Sambhutaja Charitra*. M.S. No. 191 of 1875–1876, folio 71(a) 72(b) and 92 Bhandarkar Oriental Research Institute, Pune.

[144] Kavi, R. *Manuscript* in Bhandarkar Oriental Research Institute. Pune.

[145] *Askashabhairav-Tantra*. M.S. No. 43 of 1925–1926 Bhandarkar Oriental Research Institute. Pune.

[146] Raghunatha. *Panditha Dictionary of Non-Sanskrit Terms*.

Chapter 10
Projectile Weapons: The Slingand the Bow

Prehistoric humans discovered the first missile – the stone – between Paleolithic and Neolithic period (c 10000 B.C.) – probably to kill wildlife for meat, hides and tallow. It was also a handy weapon to ward off their adversaries, both man andbeast. As the game became more wary and the enemy elusive, human's constant endeavor was to make weapons that could reach farther and hit harder. Probably, the first improvisation he made was to cast the stone instead of flinging it by.

The sling was one of the earliest long-range weapons and has been used from ancient times. It is mentioned in the Old Testament where David killed Goliath with a single stone cast with a sling. Kalidasa[147], the national poet and dramatist of India (c. 300 B.C.) also mentions the stone – sling (Bhindipala) in his Sanskrit work Raghuvamsa. Wilkinson[148] speaks of a sling found in an Egyptian tomb dating from 800 B.C., measuring about 56 cm in length and having a plaited cord.

The Indian stone sling basically consisted of a strip of leather, plaited cord or any other suitable material, with a loop at one end and a widened portion in the middle to act as a pouch. It was normally held by the right hand with the forefinger in the loop and the other gripped between thumb and forefinger. The user placed a round and smooth pebble, or a pellet of clay, or a specially shaped stone, in the central pouch, and the sling was pointed at the target, and the unlooped end of the cord was released to send the missiles at the target. Although the earlier version of the stone sling was normally of the hand type, some later versions were attached to the shaft

probably for discharging inflammable or combustible materials to be hurled into fortifications.

Ashdown said[149] "The sling appears to have been relegated to the lowest order of combatants, who occupied the rear pf the army, to send their missiles over the heads of those in front."

He also reproduces a cut from the Anglo-Saxon and Latin Pralter of Boulogue (the Chain Mail Period 1180 – 1250). This seems to differ from the Indian version in which both ends of the cord are wrapped around the right wrist and the stone was cast by swinging the pouch with the stone and giving the cord a twist by flicking the wrist to project the stone at the correct moment. Ashdown (page 94) adds: "in Woodcut No 109, page 93, a very characteristic group of soldiers of about the year 1220 is shown, taken from HARL. MS. 4751…… The Fifth is unmistakably a slinger. As was generally the rule, no protective covering was allowed the slingers – the one in question has not even a hat – who from the nature of their weapon were perhaps compelled to be always in open order – when in action and at a distance from the enemy."

The stone sling was not used extensively on the Indian battlefield, although it is occasionally mentioned in Sanskrit literature until the fourteenth century. They are still used, practically in the original form, in some rural areas of India to drive away birds feeding on crops and fruits. Some tribal people of this country still continued to use stone sling to kill small game. Ashdown continues in his chapter on the Chain Mail period (1180–1250). "At this period a weapon appears in the illuminated MSS. Which is apparently of recent introduction, namely the Staff – Sling of Fustibal. It is generally shown in besieging operations pitted against the defenders in the walls, or in normal warfare as in Fig. 110 (page 94). The action of the sling is readily seen, the loop at the end allows the bag to disengage itself automatically at the psychological moment, to discharge the stone. In this case it seems to be charged with some combustible material to be hurled. The slinger as usual bareheaded devoid of bodily defenses."

Probably, in the Mesolithic period it was discovered that a stone could be launched farther and with greater accuracy by attaching the sling across a springy twig. The twig was held at the middle with one hand and the pouch containing a stone with the other. The hand holding the twig was pointed at the target and the pouch was pulled with the other until the twig was fully bent. When the pouch was released, the twig straightened and ejected the stone to hit the target. This weapon known as the stone bow or pellet bow was more accurate than the simple sling as it could be held by the shooter by both hands and he could take better aim. An improved version of it was fitted with two bow strings, instead of one, held apart by spacers and a pouch connecting them at the middle.

From the Indian chronicles, it could be seen that the stone bow was used in the Indian battlefields from about the first millennium B.C. to the Mughal period (eighteenth century). Kalidasa[150] mentions in his *Raghuvamsha* a weapon "khsepani," which is considered to be the stone bow. Abul Fazl[151] mentions it as *Kaman-i-Gurohah*, in French[152], it was known as *arc-a-jelet*.

At some later date, the stone or pellet was missile replaced by a thin and long shaft made of reed, sane or bamboo, to increase the range of the weapon. Perhaps a little later the tip of this shaft was fitted with a pointed or shaft tip of harder material such as bone or ivory, so that it could penetrate a target deeper. The resultant product was the bow and arrow, which ultimately became the universally popular weapon for both, was a sport for well over fifty centuries.

The history of the bow covers a very long period, from the prehistoric times to the present day, during which its basic principles of working has remained practically unchanged. The latest evidence collected by archeologists from some arrow-heads excavated from African monuments indicates that the bow was used as early as 50000 B.C. at least. Canby said[153] that the Sumerian foot-soldier of about 2900 B.C. marched in ranks, was armed with a bow and spear, wore a leather helmet and carried a heavy shield.

The Vedic literature of India contains innumerable references to bows and arrows and in the *Rigveda, Yajurveda* and *Atharvaveda*. In the *Vishnupurana*, archery is classified as one of the eighteen branches of knowledge. The *Agnipurana* deals specifically with the science of archery. The main theme of the *Dhanurveda* is about bows and arrows and the correct technique of their use on battlefields. It classifies bows into four categories, one of them is the *yantramukta* which was probably a crossbow. The great Indian epics *Ramayana* and *Mahabharata* also mention many types of bows and arrows and their use by both immortals. Pant[154] records that Valmiki, in his work *Ramayana*, credits the invention of bow and arrow to Jayya and Suprabha, the two daughters of Dhaksha.

The bow-staves were made of many materials during the long period of their use. The Aryans of the Vedic period used mainly bamboo and horn. The bow-stave of *Lord Shiva's bow panika and Lord Narayana's saranga, were made of horn, and that of Arjun gandiva was made of bamboo*.

It appears that by the third century B.C. bow-staves were also made of their suitable types of Indian woods and occasionally of bone. Kautilya, also known as Chanakya, was the prime minister of Emperor Chandragupta Maurya and an excellent chronicler of the third century B.C. He wrote about contemporaneous weapons and their applications on the battlefield. Kautilya[155] classified bows into four types: *karmukha*, made of *tala* (*palmirah*), *dhanusha*, made of horn or bone, *drauna*, made of bamboo and *kodanda* made *of champa or daru wood*. It would be interesting to investigate if the four types of bows mentioned by Kautilya and the four types of European bows of the Middle Ages – the short bow, longbow, composite bow and steel bow are the same (Fig. 10.8(a)).

Ashdown said[156] "The bow was a favourite weapons of the Assyrians and was the usual Oriental pattern, being composed of horn, wood, and the large sinews of certain animals firmly glued together. It was carried partly unstrung over the shoulder when not in use." (The heroes of Ramayana and Mahabharata are invariably portrayed carrying their bows in this manner);

the total unstringing was not advisable because of the time required in getting it ready, Most Asiatic bows bending backwards into an oval shape when unstrung and required much physical exertion and time to replace the string. He also mentions that the main strength of the Egyptian armies lay in their bowmen, who fought from chariots or on foot. The bow more nearly approached the dimensions of the English patterns than the Oriental, as also did the arrow, which was at time over 30" in length. The latter was made of cane or reed, feathered and barded, their heads being of bronze. He adds, "Only one description of bows is given to us – that of *pandarus* – a Greek bow of the Heroic Age (c. 1000 B.C.). It is said to be of Ibex horn strung with sinews. The arrow-head was of iron" (Fig. 35).

Short bows, both single and double arched types, appear to be popular with the Aryans of the Vedic period, but the manner in which they were used appears to be characteristic to India alone. The bowmen were chariot mounted and shot their arrows in battle from them while on the move. Pant[157] quotes Kalidasa, to say that *karmukha* was a type of bow made of tala (palmirah), which was a favorite of charioteers. Curtius[158] records that each chariot carried six men of whom two were archers.

Before the Mauryan period, the idea of using horse mounted in warfare did not appeal of Indian commanders. And in the Mauryan period also, the practice of utilizing horse-mounted bowmen on the battlefield and to hunt from horseback with bows and arrows was adapted to a limited extent. Some wall paintings in the Ajanta caves of India, dateable to a period fifth to seventh centuries show horse-mounted warriors and sportsmen armed with bows and quivers of arrows. But such practices gradually faded out and fell into disuse shortly after the Mauryan period. It appears that the Indian commanders realized the advantages of utilizing cavalry armed with bows and arrows after confrontation with the Parthian. Indo-Scythian and Indo-Parthian coins of the second century B.C., particularly those of King Azis I, Azisiles II[159] and Satrap Zeionises[160] bear the figures of horsemen armed with bows and arrows. Perhaps one of the main reasons for the unpopularity

of the horse as a mount for bowmen was that it did not provide him a firm enough seat as the animal galloped across the battlefield while the bowmen held and discharged his bow. Only after the introduction of the stirrup by the Mongols, under Genghis Khan, made it possible for a bowman and swordsman to fight effectively from horseback. Hence, the casual historian could only surmise that the use of horse-mounted bowmen or cavalry armed with bow and arrows were introduced by the Mughal conquerors of India. However, it is a fact that in the Mughal period the Turko-Afghan invaders and rulers of India did use the horse along with the bow and arrow very successfully in warfare as well as for sport.

Indian Punch-marked coins, sculptures, murals and miniature paintings of the Late Medieval Period show that fairly short bows were popular for warfare on Indian battlefields. Many examples of such bows are extant in Indian museums.

Ancient Indian literature mentions numerous types of arrows (Fig. 10.1(a) and Fig. 10.1(b)) known variously as *ishu, bana. Atrieya Brahmana,* written in c. 600 B.C. describes how God made the arrow. The head from fire (*Agni*), the shaft from (*Vishnu*), the socket from wine (*Soma*) and the fight feathers from (*Varuna*). The *Agnipurana* mentions that the arrow is a piece of Lord Indira's (The Rain God's) thunderbolt. The authors of the great Indian epics, *Ramayana and Mahabharata*, adorned their heroes with bows and arrows capable of performing the most astounding feats. There were incendiary arrows capable of reducing the targets to ashes; there were some which could pursue the enemy, following even a zig – zag path; some could destroy an entire army whereas others could destroy only a particular organ of an adversary; and there were some, known as *khang*, which could return back to the bowman after completing its mission successfully. Apart from such fantasia, the arrows described were realistic to their range and capabilities. Vashista, an ancient Indian sage, mentions a type of arrow called *narcha*, a simple iron shifted arrow fitted with flight feathers. The Old Testament mentions the bow and arrow in many chapters.

The earliest improvisation to the reed, cane or bamboo shifted arrow was to fit arrow-heads. The earliest forms of these are simply long splinters of flint, quartz or stone, and were merely tied to or inserted over the shaft of the arrow. They were mainly lozenge-shaped and leaf shaped with a tang for fixing. Subsequently, the barbed and tangled versions were favored and the barbs making the extraction of arrows more difficult once they were embedded in the flesh. Metals such as copper and bronze were produced; arrow-heads made of these metals were fitted to arrow shaft instead of stone tips. Pant[161] mentions that arrow-heads excavated from Mohenjadaro and Harappa are mainly tipped with copper and a majority of these fashioned out of thin copper pieces with on pointed tip and two barbs at the rear. No sockets or tangs are provided to these arrow-heads to house the tip of the arrow shaft. Bamboo or arrow-shafts were merely split at the forward end, arrows-heads fitted inserted into slits, and the shafts and the heads were tied together by passing a string through holes on the provided for this purpose. Such copper arrow-heads recovered from excavations are about 3 cm long, 1.5 cm wide and 0.2 cm thick. From this it is evident that the Indus Valley Civilization had discarded the use of stone-headed arrows by about 2500 B.C. Ivory-headed arrows were in use from about the sixth century B.C. to the early part of the Medieval Period[162], about 800 A.D., whereas the metal-tipped arrows were in use up to the modern times.

In the Mauryan period Kautilya[163] also known as Chanakya was adviser and prime minister to Emperor Chandragupta Maurya in the first quarter of the fourth century B.C. (322 B.C.). He wrote the book *Arthashastra*, a splendid work on politics and the art of governance which was intended to be guide to kings, classified arrows into six types: *vanu, shara, salaka, dandasana, shan and gaudh*. He also speaks of "Arrows spitting fire" while discussing various methods of destroying forts. Pant[164] states that Kalidasa also mentions arrows such as *patrin* (feathered) sayak, bana, prastaka and so on. *Shilimukta* or *ardhachandra* (crescent shaped), *bhalla* (leaf shaped),

vishika, narach, khsurapa (razor-bladed) and so on (Fig. 10.1(a)) and (Fig. 10.1(b)).

The arrow makers (or fletchers) are mentioned in the age of the Rigveda Samita as *sukrt* and *ishkara*. Arrow-heads were made in a variety of shapes and sizes, such as forked, barbed and chisel shaped (normally for hunting). Early medieval war arrows had broad, flat-triangular or lozenge-shaped, but early fourteenth-century heads were narrow and rigid form such as pyramid shaped with three or four sides, a leaf shape of thick diamond section and a thin needle like armor-piercer of square section was introduced to penetrate body armor and shields. Goose feathers were normally used for flights and some arrows were feathered with peacock and other feathers.

The bow reached its pinnacle of glory in the hands of the Indian warriors as well as the sportsman, in the Mughal period. It was one of the most important weapons of the Mughal conquerors and rulers of India. Cavalry equipped with bows and swords were an important wing of their fighting forces. The bow now known as *kaman* was fully developed for military roles. The arrow, known as *tir*, was also suitably modified variously to suit the requirements of both the soldier and sportsman. Their bowmen were so well trained and skilled that Bernier[165] observes: "A horseman shooting arrows six times before a matchlock gun could fire twice."

The Sultans of Delhi and Deccan were perhaps the first to realize in India the importance of cavalry in the fighting forces, and henceforth the cavalry became the backbone of their armies. Their cavalrymen were usually armed with two swords and a dagger each for close quarter battles, and with a bow and a quiver of arrows for long-range engagements. Although early firearms had appeared on Indian battlefields by this period, the bow was considered an essential weapon not only for the infantry but also for the cavalry until the eighteenth century.

The Mughal bows were about four feet (1.25 m) long and were normally of the double arched type. They were normally made of buffalo horns,

although they were occasionally made of antlers of deer. A pair of horns, fairly identical was used to form the two arches of the bow-stave. Both the tips of the horn were notched, sometimes fitted with wooden tips, known as *ghoshan*, for attaching the bowstring (*chillah*). The horns were attached to a central boss made of hard wood which acted as a grip for the bowman to hold the bow. The grip was usually wrapped with sinew and covered with leather, or other suitable material. When not covered, the boss grip was varnished, painted or lacquered. However, the section of bow-stave made of horn was merely polished to a mirror finish.

The Indian bow enjoyed a very long spell of popularity, covering a period from the prehistoric times to the eighteenth century, in spite of the fact that firearms were taken into use for military purposes during the last three centuries of its use. It adorned the hands of both mortals and immortals; kings and commoners; soldiers and sportsmen; infantry and cavalrymen. Ultimately, it became the most formidable weapon in the hands of a well-trained bowman. Its effective range increased to about 200 m. And the speed at which it could dispatch arrows exceeded that of any other contemporary projectile weapons. A steel-headed arrow could pierce any but the best-made shield and breast-plate of a soldier. Arrian[166] said "Neither the shield nor the breast-plate could resist an Indian archer." No wonder the bow became the principal projectile weapon of the Indian infantryman and cavalryman up to the eighteenth century.

10.1 The Longbow

Evidence produced from some pyramids and tombs of Egypt by archeologists goes to prove that the longbow was used by ancient Egyptians (Fig. 10.10(a) to Fig. 10.10(c)). Ashdown[167] mentions that the main strength of the Egyptian armies lay in their bowmen, who fought from chariots or no foot. The bow more nearly approached the dimensions of the English pattern than the oriental, as also did the arrows, which were at times over 30″ in length. The latter was made of cane or reed, feathered and barbed,

their heads being of bronze. He added: "Only the bow is given to us – that of Pandarus – of reek bow of the Heroic Age (c. 1000 B.C.) to be of ibex horn, strung with (Fig. 35). The arrow-head is of iron."

The Indian evidence, however, indicates that the longbow was used in India by about the fourth century B.C. Rapson[168] mentions that as early as the fourth century B.C., the Indians used the longbow against the Greek invaders. He said: "…The slush under their feet made it impossible for the Indian archers to get a firm rest for their long bows." Mc Crindle[169] also mentions that the bowmen of Porus (probably infantrymen) were armed with longbows, equal in length to be the height of each bowman, and arrows nearly three yards (about three meters) long. The archers rested their bows on the ground and pressing their foot against it to discharge the arrow. Some early historians are of the views that such longbows were ineffective in the Indian type of warfare, hence their gradual disuse on the battlefields. Nevertheless, the longbow was used occasionally up to the Mughal period and was known as *kamatha*.

Probably, the Roman invaders of India introduced the longbow into Europe but it was not used by the Anglo-Saxons extensively and it ultimately reached England shortly before the introduction of gunpowder early in the fourteenth century. In is also believed by some historians that the longbow originated in Wales and was introduced in England in the twelfth century, perhaps it was Edward I who first realized its potentialities in his campaign in Wales. He adopted it as a basic arm of the English yeomen infantry and used it successfully in his southern campaigns. It was Edward III who perfected its tactical use and became the victor in the battle of Crecy. However, it soon some became a popular weapon and ultimately became the national weapon of the country.

The normal English longbow was about six feet (two meters) in length and the bow-stave was usually made out of yew and hash. However, some staves were also made out of basil, hazel and wych elm. The bow-stave was

invariably imported from Spain, Germany, Italy, Switzerland, Central and Eastern Europe.

The longbow could shoot arrows up to about a meter in length and it could discharge them faster than any other contemporary projectile weapon. The range of the longbow was twice that of the crossbow (maximum up to 400 yards) and an effective range of nearly 250 yards.

It was capable discharging arrows with great accuracy and tremendous power of penetration. In the hands of English professional yeomen, it was more accurate and had more power of penetration than the crossbow. It was lighter and so more easily handled in close quarter encounters. Also as it could be held with the bow-stave nearly in the vertical position; it was possible to pack longbow men closer in a file to obtain a denser volley of fire.

Ashdown[170] writing about the Chain Mail Reinforced Period which, according to him was between 1235 and 1325 A.D.: "From the time of the Norman conquest, the practice of archery assumed an importance which did not fall to its lot before in England. The Saxons had not paid particular attention to this arm from a military standpoint, only using it as a sport, and the success of the Normans at Hastings was due in a great measure to the skill and superior numbers of their archers. The bow appears to be of the simplest form of construction. And the arrows not decidedly of the close to a yard shaft of later age. It became a custom from a very early date for the archer to bear a stake sharpened at both ends which the first rank drove firmly into the ground with the second and uppermost point sloping from them, while the rear rank filled up the intermediate space with theirs. When protected thus in front and on both flanks it was found that the archers of England could defy the change of the heaviest cavalry."

Already in the twelfth century, the England began to develop that prowess in archery which subsequently made them renowned throughout the continent of Europe. Richard of Devizes states that at the siege of Messina by

Coeur de Lion the Sicilians were obliged to leave their walls unmanned because no one could look across as he would have an arrow in his eye before he could shut it.

Among the enactments of Henry I of England it was provided that if anyone was practicing with arrows or darts, should by accident slay another it was not to be visited against him as a crime.

An arrow from a longbow could pierce armor of about 10 cm of oak, and skilled longbow man could pin a man to his horse by sending an arrow through both legs. As late as 1790s, the longbow beat the musket in accuracy. There is an interesting event recorded according to which the English sport-loving monarch Henry III, who was a very skilled longbow man, competed against some French crossbowmen at the field of Cloth of Gold. At a range of 250 yards, the king scored consistently with his longbow, whereas the French archers were unable to hit the target with their crossbows.

Although the longbow was less powerful than the crossbow, its effective range and accuracy were better, and it was cheaper than the crossbow and early portable firearms. However, to master the use of longbow and to become proficient with it took long training and constant practice at the butts, compared to that needed with firearms. Even after the introduction of the matchlock musket in England, it took nearly 150 years for it to displace the longbow for military purposes. Blair[171] mentions that by an Order in Council in English (1595) train-bands with were issued with firearms instead of bows.

10.2 The Steel Bow

The steel bow appears to have become popular in India in the Mughal period and resembled the Persian and Turkish bows (Fig. 10.2(a) to Fig. 10.2(d)).The stave of these bows was made out of steel and rest of the components were practically the same as the shorts bows. Blair[172] records that a c. 1547 inventory of King Henry VIII includes "*Turquy bows of steele*,"

which indicates that such bows or bow-staves were imported to England from Turkey. With the bow-stave made out of steel it was now possible to beautify the bow with elaborate decoration and ornamentation. The steel bow made for the royalty and the nobility during the Mughal period, of which many examples are profusely decorated.

10.3 The Composite Bow

The composite bow also appears to have come into use in the Mughal period (Fig. 10.3(a)). Several strips of sinew were glued to a base of thin strip of wood, horn or bone and then the composite strip was shaped to form the bow-stave. In some composite bows, thin strips of wood sandwiched split horn between them and then the resultant strip was made into a bow-stave. The ends of the bow-stave were suitably shaped and noticed to take the string. Such composite construction gave the stave elasticity, flexibility and strength which added many meters to its effective range. In a contest held in 1790s the composite bow was able to out-distance the longbow, shooting more than 440m.

The composite bow-staves with a horn base were usually undecorated but well polished. When the base was wood it was either polished or painted or varnished. The composite bow is mentioned in many European annals of fourteenth and fifteenth centuries. Gay[173] refers to "Turkey bows" presumably composite bows made in Turkey.

Composite bows were generally imported into Europe and England from the East.

10.4 The Crossbow

Basically, the crossbow is a short bow fitted with a tube to hold the arrow in place across the bow-stave, a stock or handle to it (the so-called tiller), and a trigger arrangement to release the arrow when desired (Fig. 10.4(a) toFig. 10.4(c)).

Although the exact origin of the crossbow is still obscure, there seems to be little doubt that it was known to the Chinese as early as the first millennium B.C. The chronicles of the Vedic period, however, do not include any descriptions of weapons which could now be interpreted to mean crossbows. Nevertheless, Pant[174] writes that the weapon mentioned as the *nalika* in ancient Sanskrit literature was a crossbow. Perhaps his presumption is based on the fact that crossbow is invariably fitted with a tube (*nalika*) to hold an arrow in place. He also specifically mentions that a hollow piece of horn was fitted over the stock which contained arrows about nine inches long, and the arrows were discharged one by one by a trigger.

The hand crossbow was used on Indian battlefields probably from the third century A.D. It was mainly used as an infantry weapon and occasionally as a cavalry weapon. A Sanskrit inscription[175] at Avanthipuram, in South India, reads: "…Of him who has the name of Ananta impelled with speed and skillfully discharged from the machines of his bow fitted with the well stretched string…." Obviously, the machine referred to was a hand crossbow.

From the Indian chronicles of the Late Medieval period, it could be seen that the Delhi Sultans, probably Iltutmish, adopted the crossbow for military use. It was continued to be used in the Mughal period and was known as *takhsh-kamman*, and its arrow was known as *novak*. However, Blochman[176] was of the view that the takhsh-kamman mentioned in the *Ain-i-Akbari*[177] was a small bow and the novak was a pipe through which an arrow was shot. Nevertheless, the crossbow used by the Mughals appears to be a very large version of the hand type, or called the wall-type, and was used mainly as a siege engine, or as a defensive weapon for forts and castles. They seemed to prefer the short bow for infantry and cavalry.

10.5 The European Crossbow

Most probably the Roman invaders of Indian learnt about the crossbow (Fig. 10.5(a) to Fig. 10.5(f)), particularly the wall-type, and introduced it into

Europe in the medieval period. The Norman archers used them and spread them throughout Europe and England. It was generally known as the arbalest and a crossbowman an arbalester. Although it soon became very popular, in England it was adopted only to a very limited extent. The large wall-types were mainly used as defensive weapons for castles, fortresses towns, and ship and for hunting game. It was not popular as a military weapon as it was a clumsy weapon and much slower in action than the English longbow – the medieval bowman's finest tool! Whereas the crossbow played the same role as the longbow had in England, until it was replaced by firearms.

However, the Church considered the crossbow (Fig. 10.7(a) to Fig. 10.7(j)) a barbarous weapon and the Second Latern Council (1139) prohibited its use in battles by Christian nations. Nevertheless, it was used extensively by the Christian crusaders against the heathens without compunction. An improved version of the hand crossbow, or called the arbalest, could pierce plate armor and had an effective range of about 100 meters.

Ashdown said[178] "In a woodcut No 109 a very characteristic group of soldiers of about the year 1220 is shown, later from Harl.MS.4751. The heavily armored arbalester in plot-helmet and mail is one of a force defensive a castle and has discharged a quarrel which transfixes an archer of the attacking party. An arbalester is probably shown in the third position from the front. With them is also an archer also discharging combustibles affixed to the end of an arrow."

Wilkinson[179] and Blair[180] described the fully developed European crossbow as: "A long wooden bar known as the tiller (Stock) had the bow staff at one end set at right angles to it. A thick bowstring was attached to the sow-staff which could be pulled back until it could be engaged with a small, squat and movable cylinder pivoted to the top of the tiller, the so-called nut or cylinder. The nut held the bowstring in the fully drawn position and locked it in the fully drawn condition. The nut, usually made out of horn, had one large and one shallow notches cut on its surface. When the large

notch was brought to the top position by rotating the nut, a trigger sear engaged the shallow notch and locked the nut in this position. The bowstring was then spanned and hooked to the large notch of the nut. The crossbow was thus fully spanned."

To shoot with the crossbow, an arrow which was rather short and thick generally known as bolt or quarrel was placed in a shallow groove – called the gutter or chase – cut on top of the tiller with the rear end of the quarrel resting against the center of the bowstring. When the trigger, normally a long under lever, was pressed the trigger sear was disengaged and this allowed the nut to rotate forward and to release the bowstring, which in turn drove the quarrel forward as the bowstring whipped back to the unspanned position.

Although this type of nut survived until the nineteenth century, as early as the seventeenth century it was often replaced by a hooked metal tumbler, especially on stone crossbows (Fig. 10.6(a) to Fig. 10.6(d)).

From the mid-sixteenth century, a curved clip made out of horn was fitted over the nut of the crossbow, along the tiller, to hold the quarrel lightly in position over the tiller. From the end of the century some German crossbows were fitted with a circular cover along the chase and along the tiller, sometimes referred to as a barrel. This probably performed the same function as the clip mentioned earlier. It is also quite probably that this barrel served the purpose of a magazine for small quarrels.

The simplest form of trigger to release the quarrel found on surviving examples of hand crossbows is a Z-shaped metal strip pivoted within a recess cut in the tiller. Its forward tip is shaped to form a sear and its rear end, the trigger proper, is extended as a long under lever following the bottom line of the tiller. At some unknown date, but before the end of the fifteenth century, a trigger spring was added to keep it pressed into the shallow notch on the nut. By the middle of the nineteenth century, crossbows were normally fitted with the nut held by a small tumbler-like

sear to hold that nut by the shallow notch with the help of one or more pivoted levers.

Crossbows used for hunting and target shooting were sometimes fitted with a set-trigger, in addition to the normal lever trigger, similar to those fitted to contemporary wheel lock firearms. Blair[181] mentions that on the late sixteenth and seventeenth century, examples fitted with set-trigger, a narrow rod was inserted into a hole on top of the tiller to bear down on a spring operated lever until it is engaged with a stop on the set-trigger. A slight pressure on the set-trigger released this lever and the tension in the spring pushed it upward to operate the main trigger mechanism and to release the bowstring. In the seventeenth century, two more improvisations were introduced: first, a button to operate the set-trigger mechanism and later a small trigger-like lever in place of this button.

Early European hand crossbows were simply spanned by hand but when they were made with stronger and tougher bow-staves the crossbowman used both his legs and hands to draw the bowstring. He held the bowstring with his hands, pushed his feet against the bow-stave and pulled the bowstring until it was engaged by the nut. By the thirteenth century, a hooked iron strip, the stirrup was introduced to facilitate the spanning and was attached to the girdle of the bowman. When such a stirrup was provided, the bowman simply leaned forward, hooked the stirrup to the bowstring, straightened his body until the bowstring could be attached to the nut and then disconnected at the stirrup.

Hewitt[182] and Gay[183] mention mechanical spanning devices of crossbows were used from the early fourteenth century. According to Blair[184] they were variously known as tour, vice, haussepic, windlass or windless; and from the early fifteenth century as *canequin and pied-de-chienne* (Butcher's foot) or orpied-*de-chevre* (Goat's Foot).

A few illustrations dating from the fourteenth century onward showing large wall crossbows (Espringals) spanned by a mechanical device at the rear

of the tiller. Normally, it consisted of a longitudinal screw to which the bowstring was hooked and a nut with four handles which could be turned by hand to span the string more or less as a capstan used to haul the anchor of a ship.

The crossbow quarrels were fitted with many types of heads to suit various purposes. The standard warhead small and heavy, diamond sectioned and leaf, or lozenge-shaped. The shaft was normally made out of wood and was feathered with two large wooden or parchment flights.

Some hand crossbows were designed to discharge round stones or clay pellets. Such stone, or pellet, crossbows of the late sixteenth to mid-nineteenth centuries had metal gaffles built into the top of the tiller. They normally consisted of a straight lever, pivoted at the bottom of the tiller, with a short pivot arm terminating in a hook. The gaffle was not only used to span the bowstring but also served the purpose of the notched nut on large crossbows. They were also equipped with locking and releasing mechanisms.

The stone or pellet,-crossbow (Fig. 10.9(a) & Fig. 10.9(b)) was a very light weapon designed to shoot clay pellets, lead balls and round stones to kill game. They are mentioned as early as the fourteenth century. Instead of the normal single bowstring as in the case of the hand crossbow, the stone crossbow had two bowstrings held apart by a bone of horn space and having a pouch connecting both the strings at the center. They were spanned either by hand or with a built-in gaffle.

Ballista

Fig. 1.1 (a)

Fig. 1.1 (b)

Fig. 1.2 (a)

Arablest Fig. 1.2 (b)

Fig. 1.2 (c)

Fig. 4.6 (a)

Fig. 4.6 (b)

Onager

Bambard

Mangonel

Fig.4.2 (a)

Fig. 4.2 (b)

Trebuchet

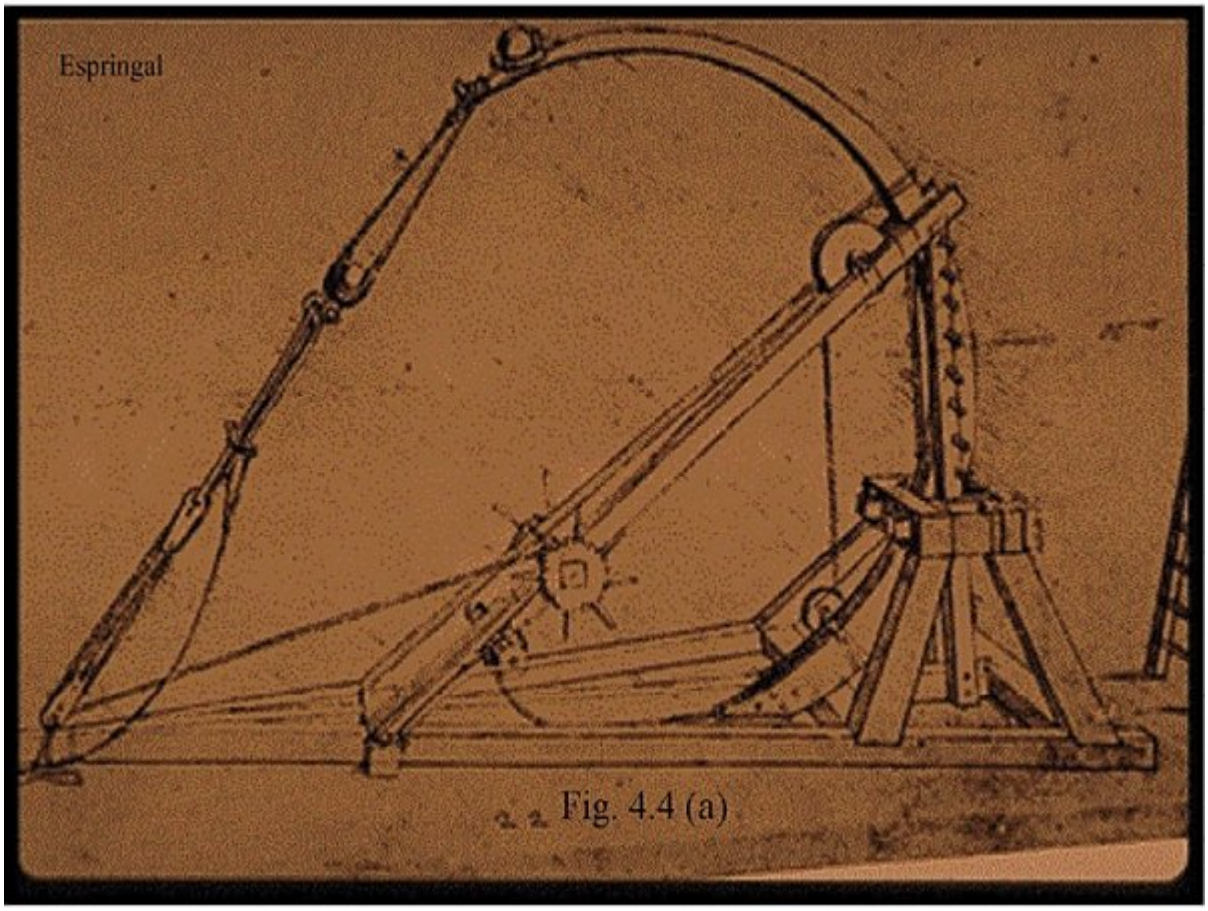


Fig. 4.4 (a)

Manjaniq

Fig. 4.5 (a)

Fig. 4.5 (c)

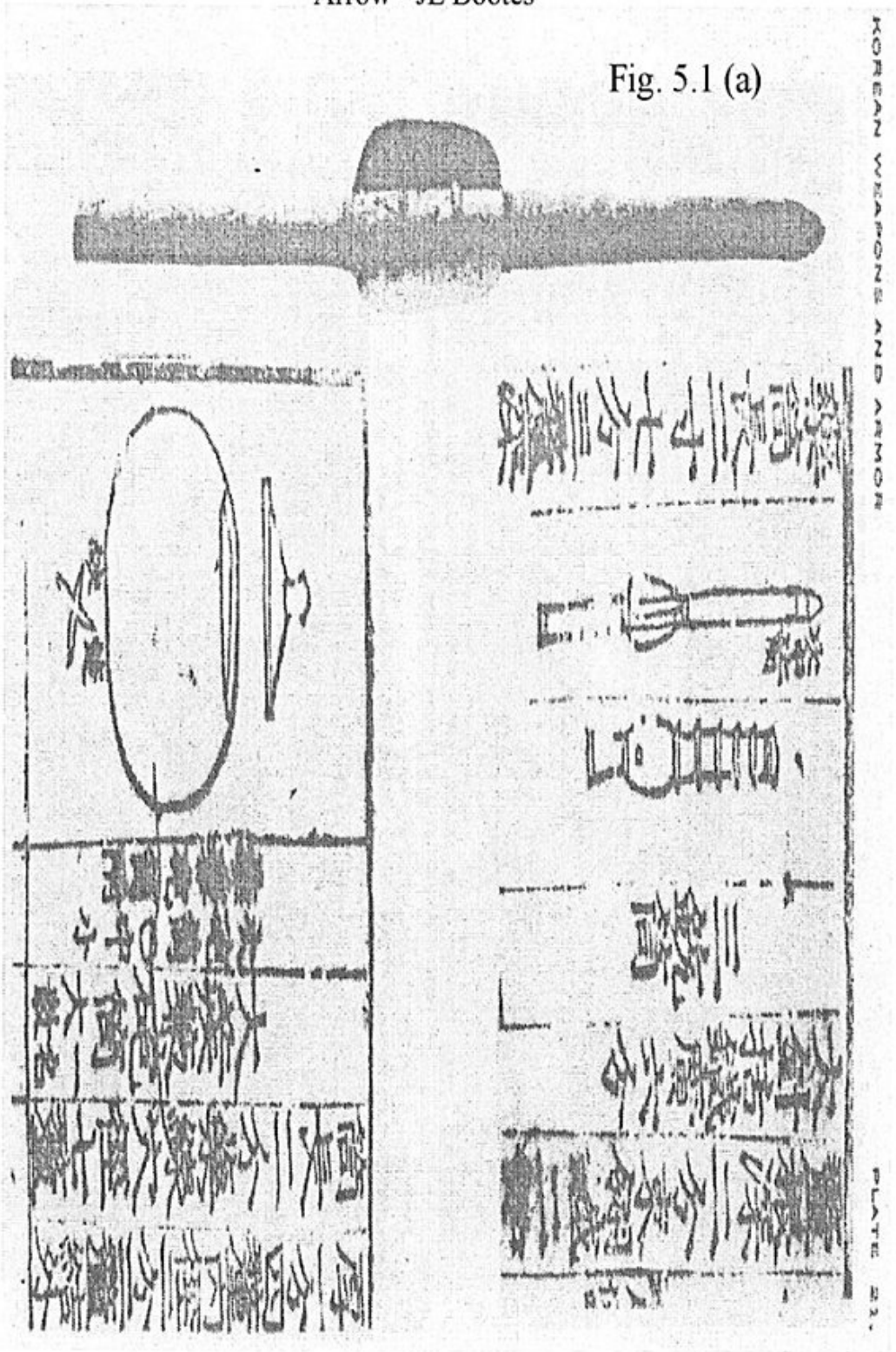
Fig. 4.5 (b)

A BATTLE SCENE,
MUGHAL, EARLY 16th Cent. A. D.

Fig. 4.9 (a)

Arrow - JL Bootes

Fig. 5.1 (a)



KOREAN WEAPONS AND ARMOR

PLATE 82.

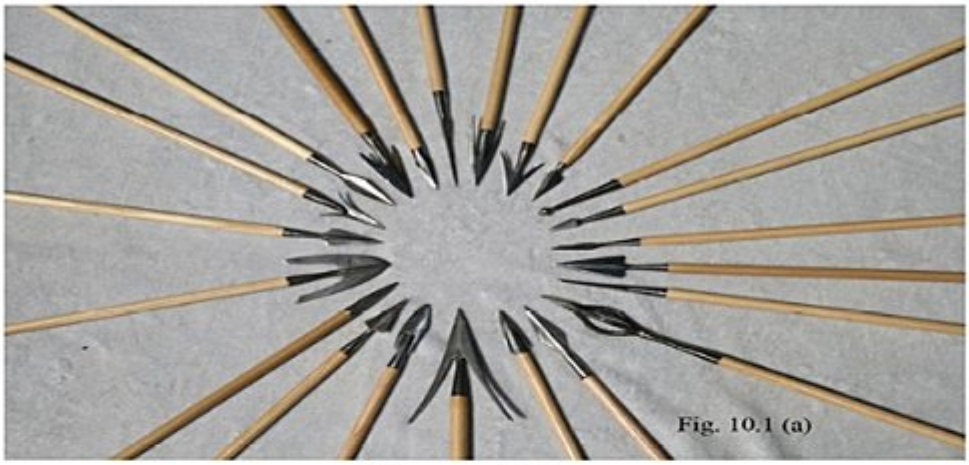
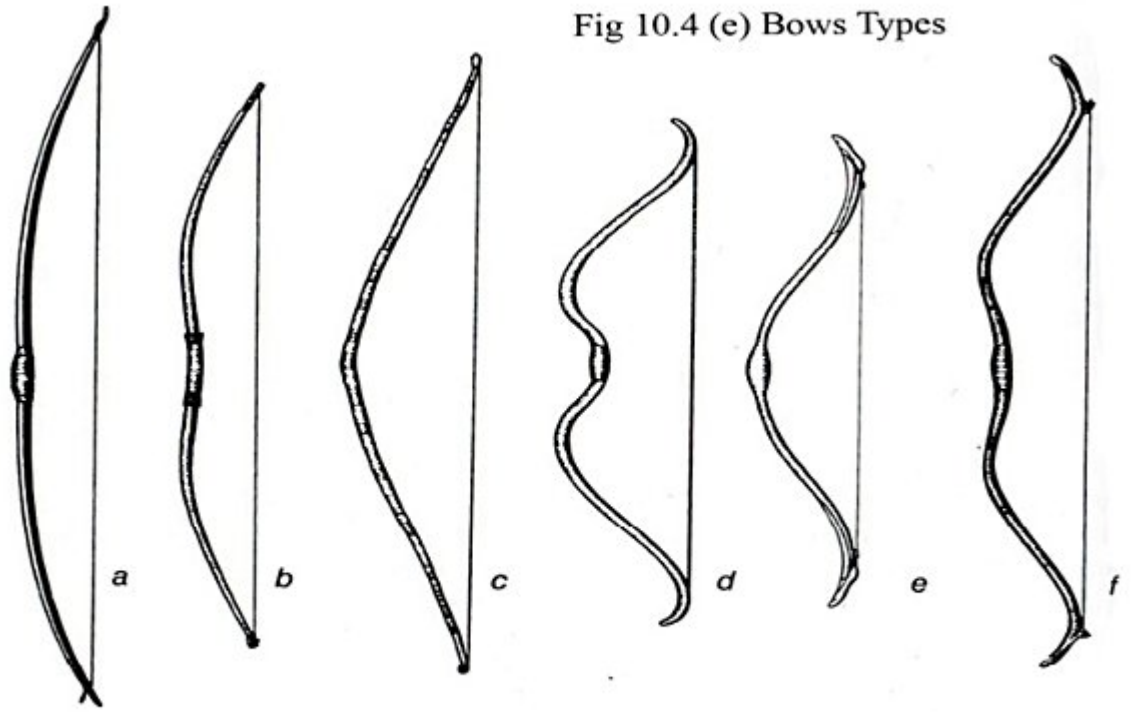


Fig. 10.1 (a)

Types of Arrows

Fig. 10.1 (b)

Fig 10.4 (e) Bows Types



. Representative types of bow designs: (a) Medieval yew longbow; (b) sinew-reinforced Native American double curved bow; (c) Western Asian angular composite bow; (d) Scythian composite bow; (e) 17th century Turkish composite bow; and (f) 17th century Crimean Tatar composite bow.

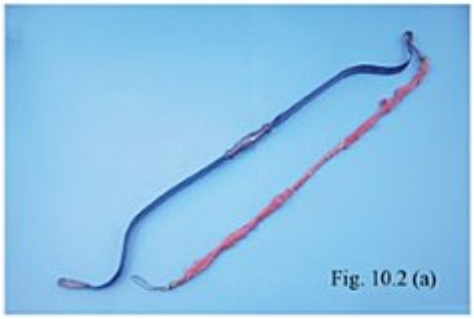


Fig. 10.2 (a)

Fig. 10.2 (b)

Steel Bows

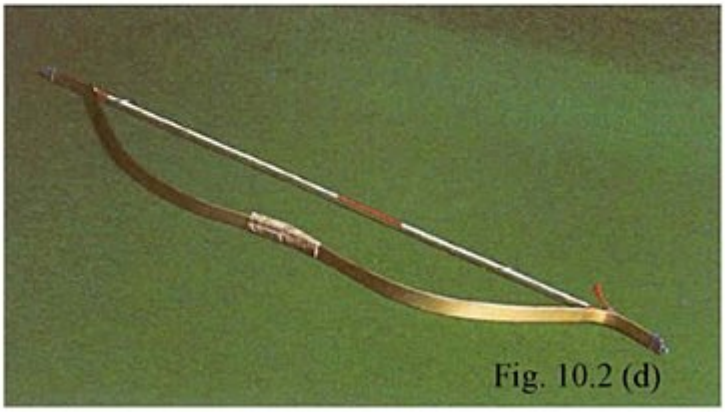


Fig. 10.2 (d)

Fig. 10.4 (a) Cross Bow

Composite Bow

Europeans Crossbows

Fig. 10.5 (a)

Fig. 10.5 (b)

Fig. 10.5 (c)

Fig. 10.5 (d)

Fig. 10.5 (e)

Fig. 10.5 (f)

Stone Crossbows

German Cross Bows

Fig. 10.7 (a)

Fig. 10.7 (b)

Fig. 10.7 (c)

Fig. 10.7 (d)

Fig. 10.7 (e)

Fig. 10.7 (f)

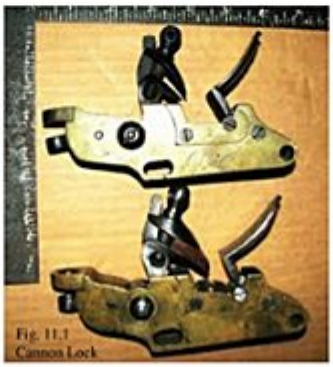
Fig. 10.7 (g)

Fig. 10.7 (h)

Fig. 10.7 (i)

Fig. 10.7 (j)

Pellet Cross Bows

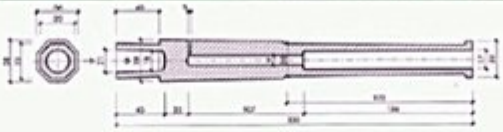


Cannon Lock

Tannenberg Gun

Fig. 11.3 (a)

Fig. 11.3 (b)



Morko Gun

Fig. 11.4 (a)

Fig. 11.4 (d)

Hand Cannon

Fig. 11.2 (a)

Fig. 11.2 (b)

Fig. 11.2 (c)

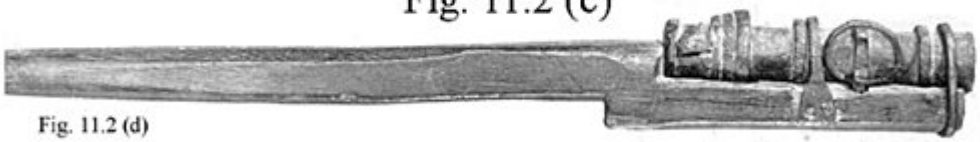


Fig. 11.2 (d)

Fig. 11.2 (e)

Match Lock

Fig. 11.5 (a)

Fig. 11.5 (b)

Fig. 11.5 (c)

Fig. 11.5 (d)

Fig. 11.5 (e)

Fig. 11.3 (f)

Fig. 11.5 (g)

Fig. 11.5 (h)

Fig. 11.5 (i)

European Matchlock

Fig. 11.6 (c)

Fig. 11.6 (d)

Sear Matchlock

Fig. 11.9 (a)

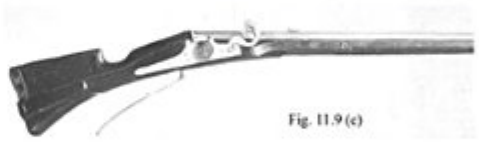


Fig. 11.9 (c)

Fig. 11.9 (b)

Fig. 11.9 (e)

Fig. 11.9 (d)

Merz Matchlock

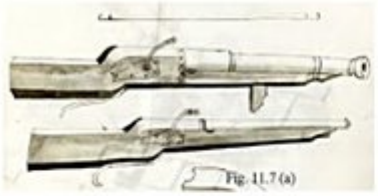


Fig. 11.7 (a)

Fig. 11.7 (c)

Fig. 11.7 (d)

Snap Matchlock

Fig. 11.8 (b)

Fig. 11.8 (d)

Indian Matchlock

Fig. 11.10 (f)

Fig. 11.10 (g)

Fig. 11.10 (h)

Fig. 11.10 (i)

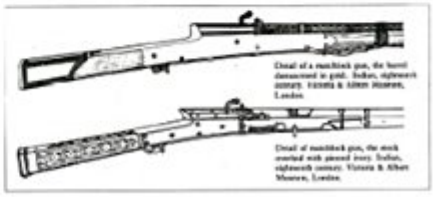


Fig. 11.10 (j)

Tschunkes

Fig. 11.12 (a)

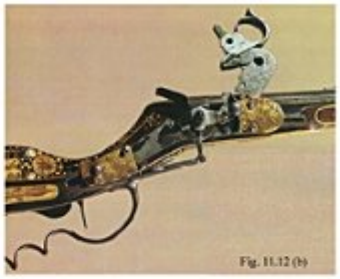


Fig. 11.12 (b)

Fig. 11.12 (c)

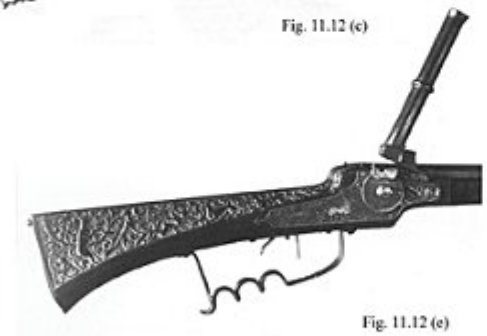


Fig. 11.12 (e)

Fig. 11.12 (d)

Fig. 11.12 (f)

Fig. 11.12 (g)

Fig. 11.12 (h)

Wheel Lock

Fig. 11.11 (a)

Fig. 11.11 (b)

Fig. 11.11 (c)

Fig. 11.11 (d)

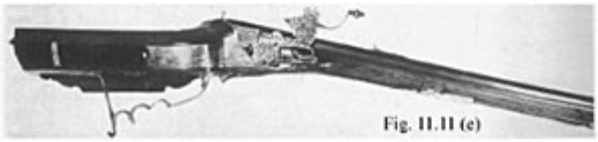


Fig. 11.11 (e)

Sear Match Lock

Fig. 11.9 (a)

Fig. 11.9 (b)

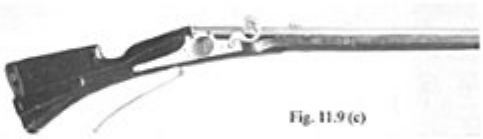


Fig. 11.9 (c)

Fig. 11.9 (d)

Fig. 11.9 (e)

Fig. 11.13 (a)

Wheel Lock Pistols

Fig. 11.13 (b)

German Wheel Lock Guns - Stocks

Fig. 11.14 (a)

Fig. 11.14 (b)

Fig. 11.14 (c)

Fig. 11.14 (f)

Spanish Wheel Lock Guns - Stocks

Fig. 11.15 (a)

Fig. 11.15 (b)

Fig. 11.15 (c)

Sardinian Wheel Lock Guns - Stocks

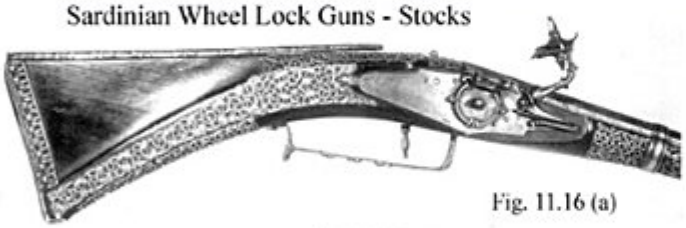


Fig. 11.16 (a)

Fig. 11.16 (c)

Fig. 11.16 (e)

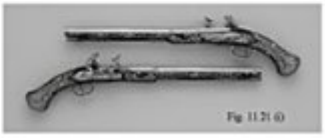
Fig. 11.16 (d)

Snaphaunce/Snap Lock

Fig. 11.21 (d)

Fig. 11.21 (e)

Fig. 11.21 (f)



Dutch Wheel Lock Gun - Stock

Fig. 11.17 (a).

Italian Wheel Lock Guns - Stock

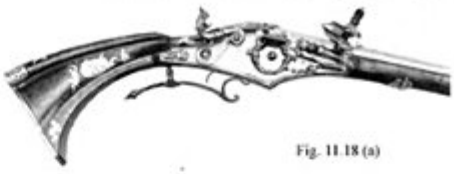


Fig. 11.18 (a)

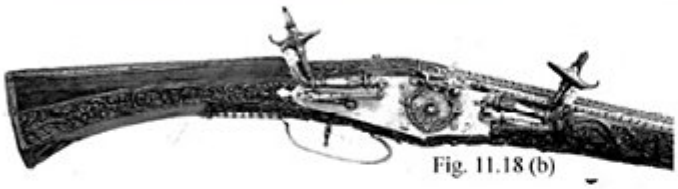


Fig. 11.18 (b)

Fig. 11.18 (c)

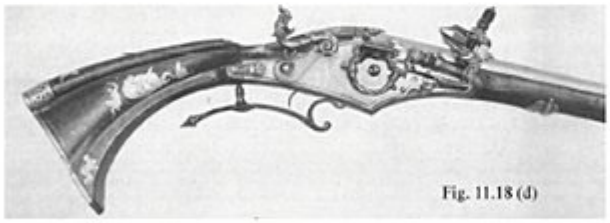


Fig. 11.18 (d)

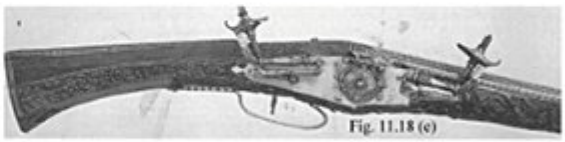


Fig. 11.18 (e)

French Wheel Lock Guns - Stock

Fig. 11.19 (a)

Fig. 11.19 (b)

Wheel Lock Pistols - Stock

Fig. 11.20 (a)

Fig. 11.20 (b)

Fig. 11.20 (c)

Italian Snaphaunce/Italian Lock

Fig. 11.25 (a)

Fig. 11.25 (b)

Fig. 11.25 (c)

Fig. 11.25 (d)

Fig. 11.22 (a)

Petronel

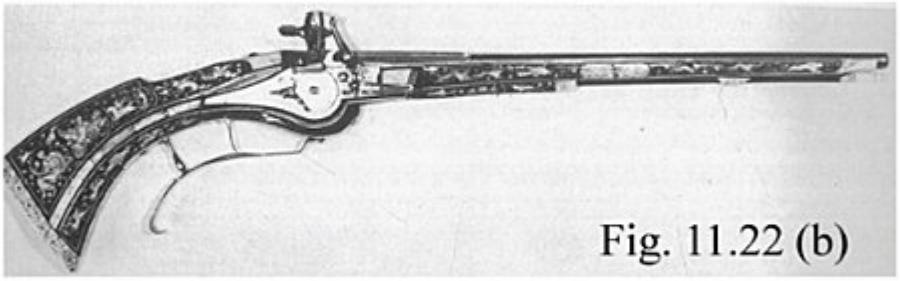


Fig. 11.22 (b)

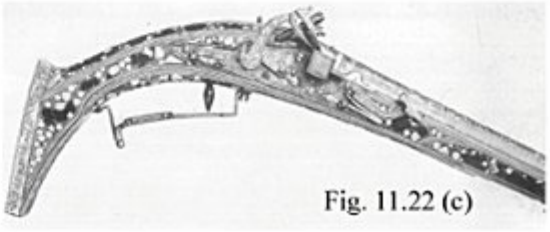


Fig. 11.22 (c)

Fig. 11.26 (a)

Roman Lock/Italian Lock

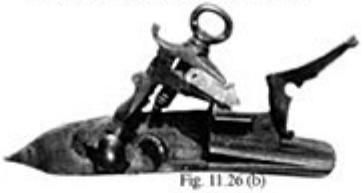


Fig. 11.26 (b)

Fig. 11.26 (c)

Fig. 11.26 (e)

Fig. 11.26 (d)

Fig. 11.26 (f)

Fig. 11.26 (g)

Florentine Lock/Brescian Lock

Fig. 11.27

Turin Lock

Fig. 11.28 (a)

Maldo - Wallachian Snaphaunce Lock

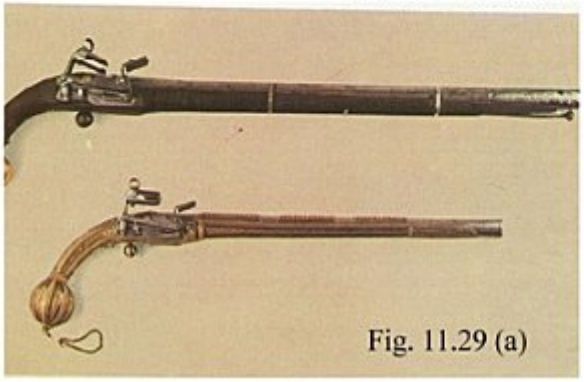


Fig. 11.29 (a)

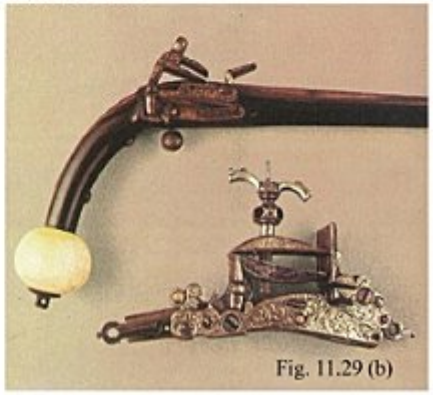


Fig. 11.29 (b)

Turkish Miquelet Lock

Fig. 11.35 (a)

Fig. 11.35 (b)

Fig. 11.35 (c)

Fig. 11.35 (d)

Fig. 11.35 (f)

Scottish Snaphaunce Lock

Fig. 11.35 (e)

Fig. 11.35 (g)

Fig. 11.35 (h)

Fig. 11.35 (i)

Persian Miquelet Lock

Fig. 11.32 (a)

Fig. 11.32 (b)

Fig. 11.32 (c)

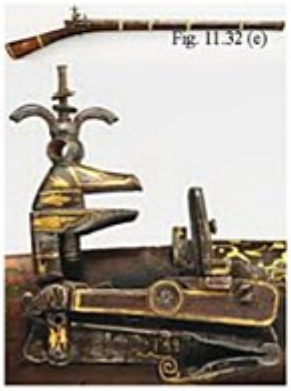


Fig. 11.32 (e)

Fig. 11.32 (d)

Fig. 11.32 (f)

Arab Toe Lock

English Snaphaunce Lock

Fig. 11.34 (a)

Fig. 11.34 (b)

Fig. 11.34 (c)

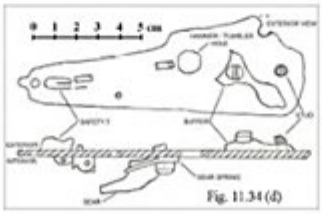


Fig. 11.34 (d)

Fig. 11.34 (e)

Dog Lock

Fig. 11.37 (a)

Fig. 11.37 (b)

Fig. 11.37 (c)

Fig. 11.37 (d)

Fig. 11.37 (e)

Fig. 11.37 (f)

Fig. 11.37 (g)

Fig. 11.37 (h)

Fig. 11.38 (a)

Fig. 11.38 (b)

Snaphaunce Long Gun

Fig. 11.38 (c)

Fig. 11.38 (d)

Snaphaunce Lock Pistols - Stock

Fig. 11.41 (b)

Fig. 11.41 (a)

Flint Lock/Fire Lock

Fig. 11.42 (a)

Fig. 11.42 (b)

Fig. 11.42 (c)

Fig. 11.42 (d)

Fig. 11.42 (e)

Fig. 11.42 (f)

Fig. 11.42 (g)

Fig. 11.42 (h)

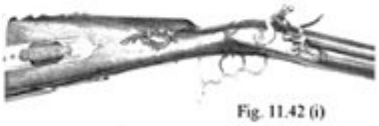


Fig. 11.42 (i)

Fig. 11.42 (j)

True Flint Lock

Fig. 11.43 (a)

Fig. 11.43 (b)

Fig. 11.43 (c)

Fig. 11.43 (d)

Fig. 11.43 (e)

Fig. 11.43 (f)

Fig. 11.43 (g)

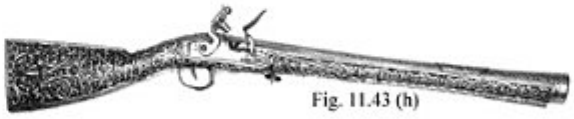


Fig. 11.43 (h)

Fig. 11.43 (i)

Long Bow

Fig. 10.10 (a)

Fig. 10.10 (b)

Marks 1

Fig. 12.1 (a)

Amsterdam Antwerp Augsburg Barcelona Birmininghamm

Birmingham

Charleville

Denmark & Norway 1588-1648

Denmark & Norway 1670 - 99

Denmark & Norway 1699-1730

Denmark & Norway 1730-46

Denmark & Norway 1746-66

St. Etienne

St. Etienne

Leyden

Marks 2

Fig. 12.1 (b)

Liege

London
Gunmakers Co.

London
Gunmakers Co.
1638

Foreigners Mark
London
Gunmakers Co.
1741

Private
Proof Mark
British Board
of Ordnance

Maestricht

Nuremberg

Saxony

Strasbourg

Utrecht

Suhl

Vienna

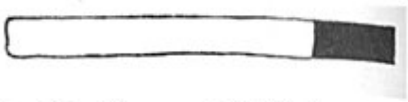
Wiener-Neustadt

Passau

Copied Especially
in Solinggen

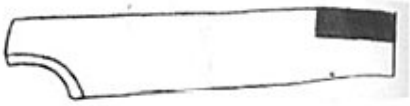
Fig. 12.2 (a)

Cheek Butts



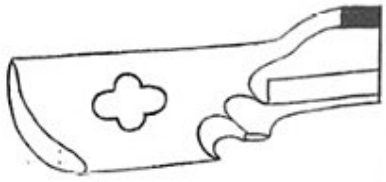
Hand Gun European 14th Century

Butt of Snap Matchlock Rifle
North European c 1500



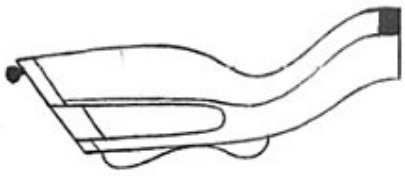
Straight Butt Shoulder Niche European15th Century

Elementary Shaped Butt German c 1500

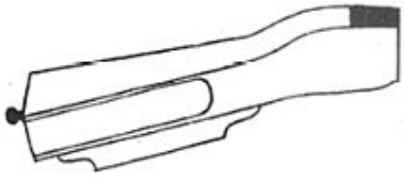


Later Snap Matchlock c 1600

German Butt mainly on Wheellock Rifles
c 1530 onwards



Wheelloock "Tschinke" Rifle
Silesian c 1620-1660



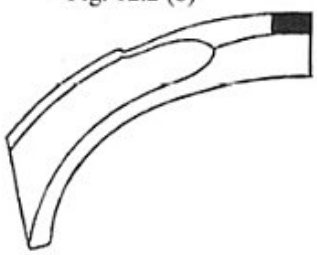
Late type of German Butt pronounced
drop deeper cheek piece

Wheellock Rifle German c 1620

Fig. 12.2 (b)

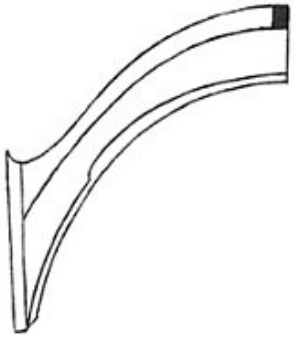
Shoulder & Chest Butts

German type Butt. Russian 17th Centruy



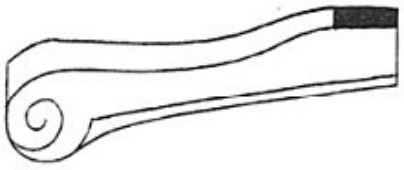
Petronel Swiss c 1590

Transitional Butt European c 1600

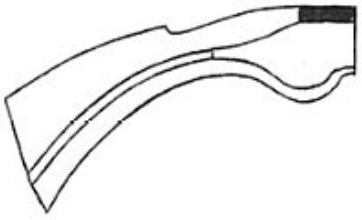


Petronel English Dated 1584

Triangular Musket Butt European 17th Century



Semi Rounded Butt German
c 1540



Petronel French c 1600

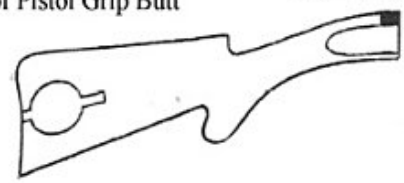
Rounded Butt German c 1600

Paddle Shaped Carbine Butt
North European c 1620-1660

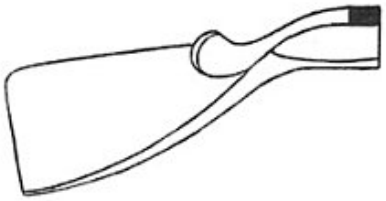
Fig. 12.2 (c)

Development of Pistol Grip Butt

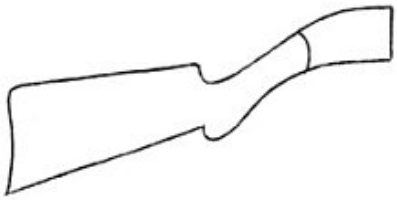
French c 1640



German c 1850

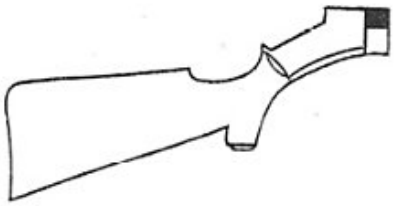


English c 1650

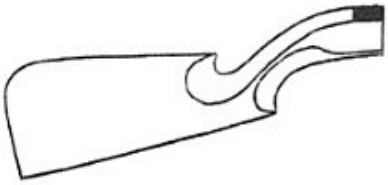


American c 1880

Swiss c 1650

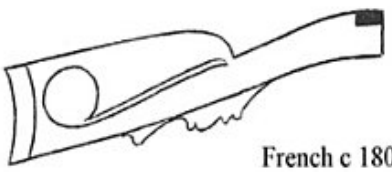


American c 1880



French c 1675

French c 1850

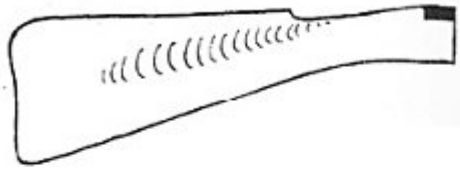


922

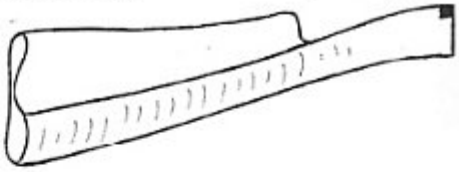
French c 1800

Development of Straight European Butt

Fig. 12.2 (d)

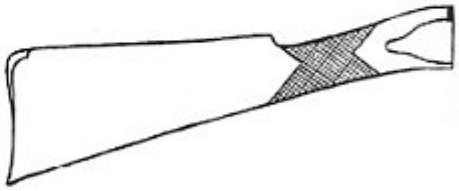


Rounded Wrist extending down lower edge of Butt. Flat Butt Plate c 1680



Tubular Wrist extending to Butt-Plate high comb. Found mainly on French & German Muskets c 1740-1780

Pronounced Wrist, rounded Butt-Plate c 1700



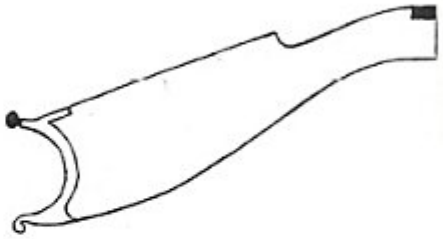
Straight line from pointed toe of Butt-Plate to lock c 1780 onwards

Fig. 12.2 (d)

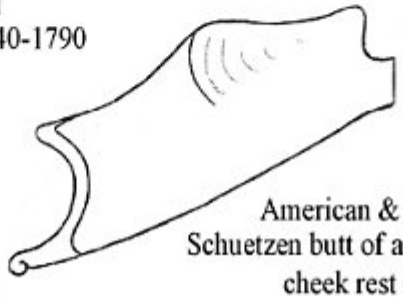
Large Bulbous "Heel" on Butt-Plate
c 1690

American & Schuetzen Butts
heavu curved Butt-Plate
straight narrow butt, flat sides
American c 1780 onwards

Less pronounced Heel,
Tow of Butt is Pointed still
will extended Tubulat Wrist c 1740-1790

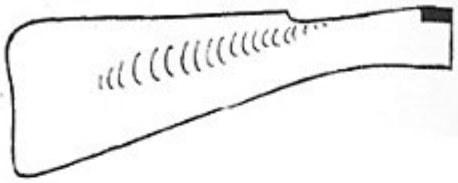


American & Schuetzen Butts
Schuetzen butts semi circular butt plate
increased drop from line of barrel to allow
for standing firing position American
c 1850 onwards

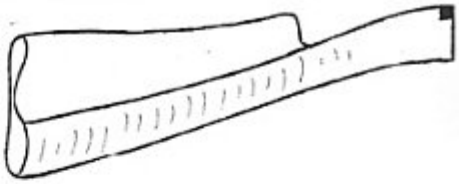


American & Schuetzen Butts
Schuetzen butt of advanced design, with raised
cheek rest German c 1870

Development of Straight European Butt Fig. 12.2 (d)



Rounded Wrist extending down lower edge of Butt. Flat Butt Plate c 1680



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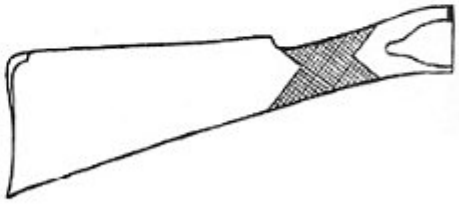
Pronounced Wrist, rounded Butt-Plate c 1700



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American c 1780 onwards

Less pronounced Heel,
Tow of Butt is Pointed still
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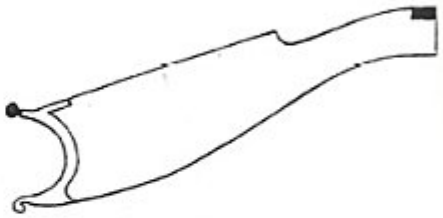
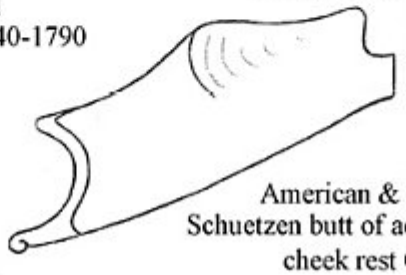


American & Schuetzen Butts
Schuetzen butts semi circular butt plate
increased drop from line of barrel to allow
for standing firing position American
c 1850 onwards



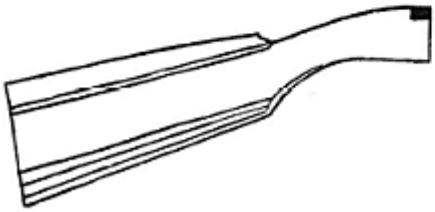
American & Schuetzen Butts
Schuetzen butt of advanced design, with raised
cheek rest German c 1870

Fig. 12.2 (e)

Mediterranean Butts

Spanish (Catalan) 18-19th Century

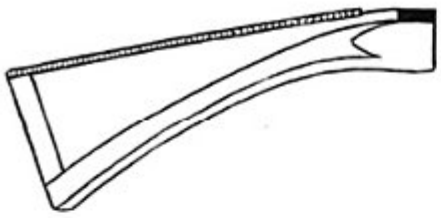
Albanian 18-19th Century



Spanish (Madrid) 18-19th Century

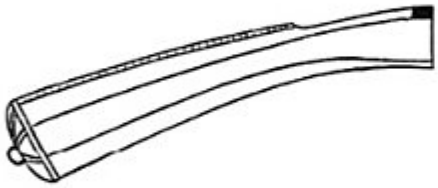
Albanian 18-19th Century

Fig. 12.2 (e)



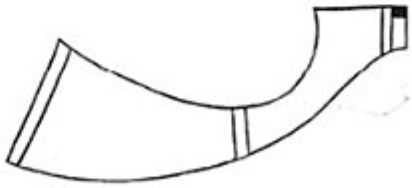
Sardinian 17-18th Century

Turkish 18-19th Century



Italian 17th Century

Circassian 18-19th Century

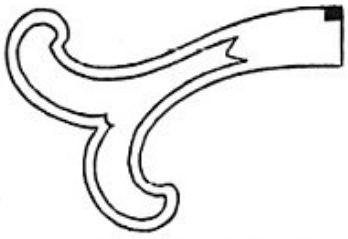


Afghan 18-19th Century

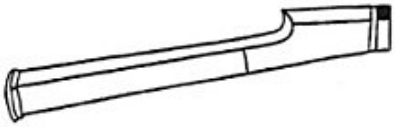
Oriental Butts

Fig. 12.2 (f)

Indian 18-19th Century



Chingalese 17-18th Century



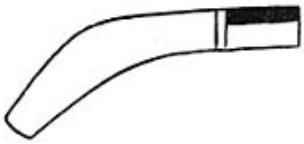
Indian (Deccan) 18-19th Century

Indonesian 18th Century

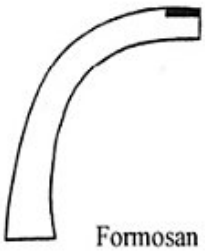
South Indian (Coorg) 18-19th Century

Japanese 18-19th Century

South Indian (Coorg) 18-19th Century



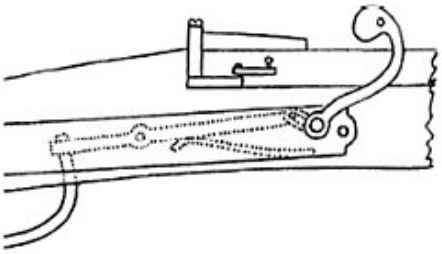
Chinese 18-19th Century



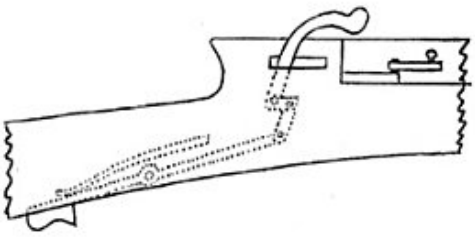
Formosan 18-19th Century

Gun Locks

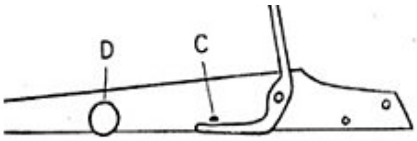
Fig. 12.3 (a)



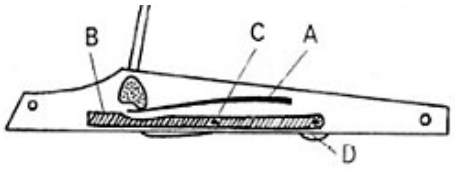
European Match Lock



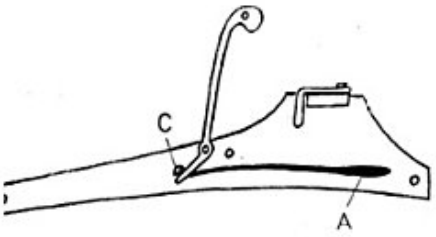
Indian Match Lock



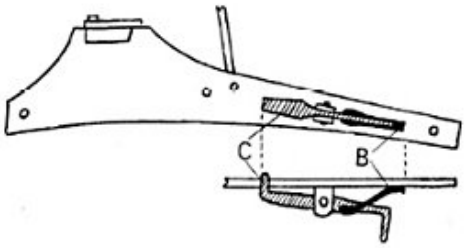
European Snap Match Lock



European Snap Match Lock



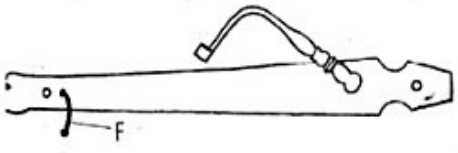
European Snap Match Lock



European Snap Match Lock

Gun Locks

Fig. 12.3 (b)



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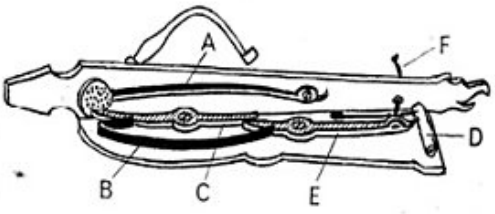

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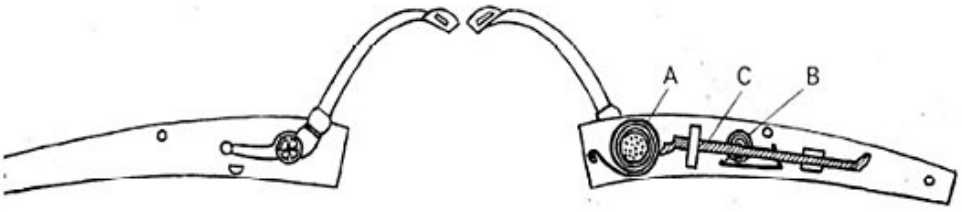
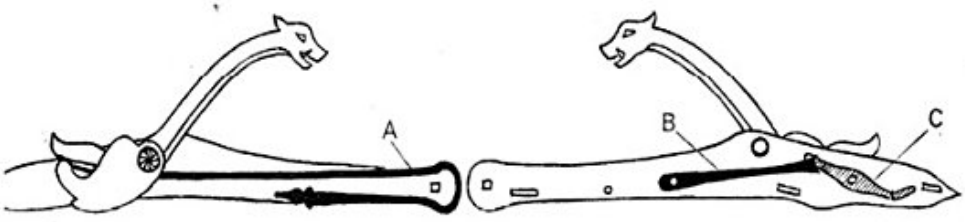


Japanese Snap Match Lock

Japanese Snap Match Lock

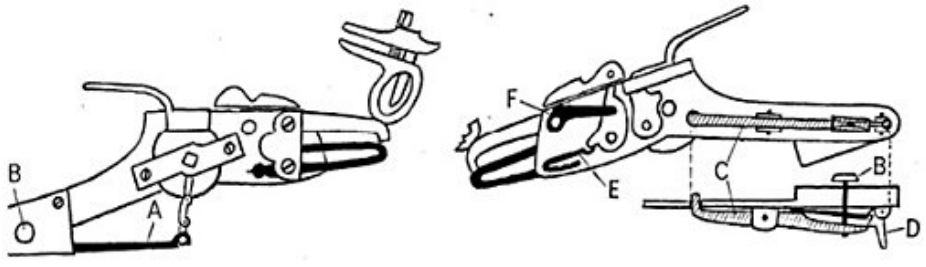


Javanese Snap Match Lock

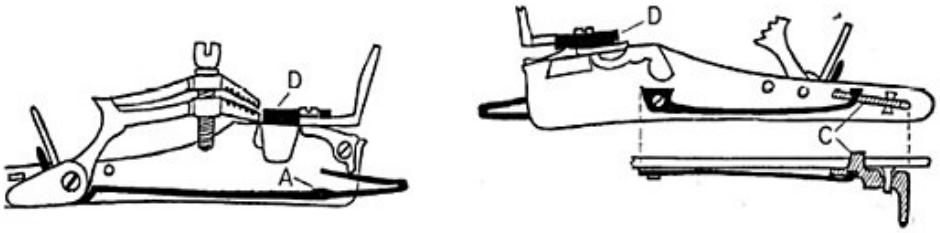
Javanese Snap Match Lock

Gun Locks

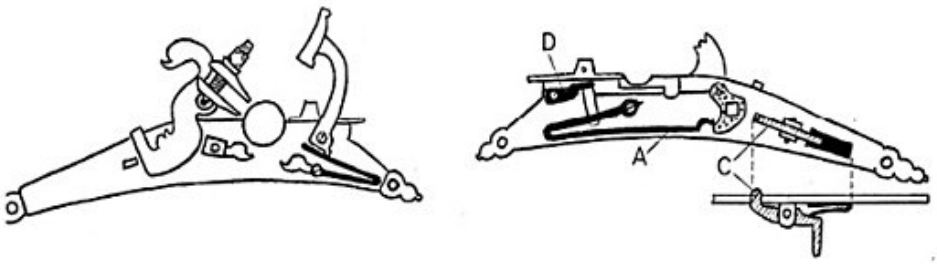
Fig. 12.3 (c)



Tschinke Wheel Lock



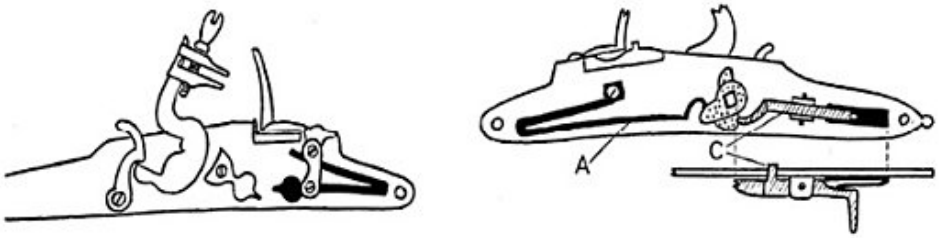
Norwegian Flint Lock



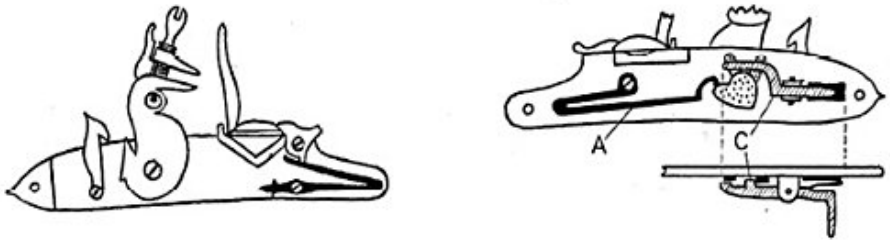
Scottish Snaphaunce

Fig. 12.3 (d)

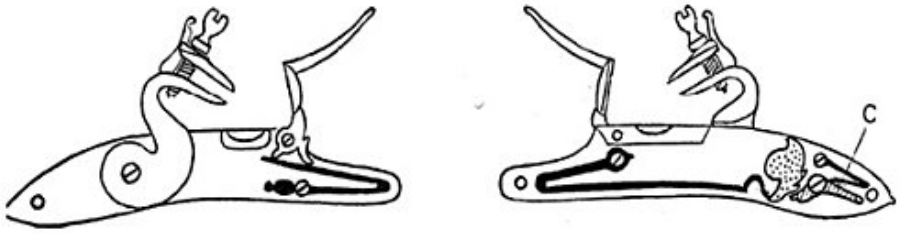
Gun Locks



English Lock



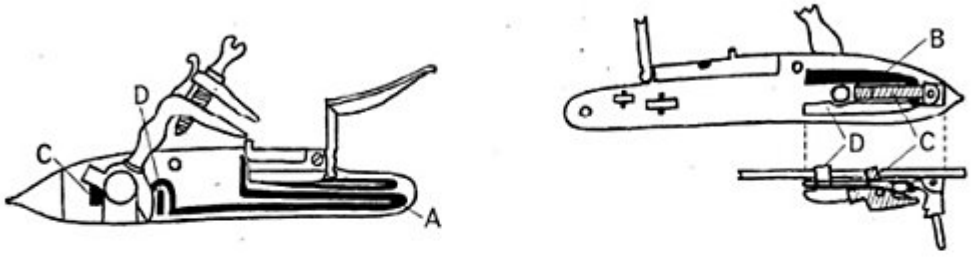
Dog Lock



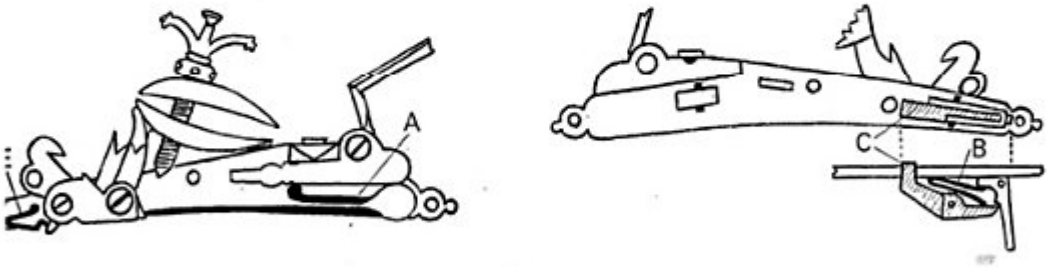
French-Type Flint Lock

Fig. 12.3 (e)

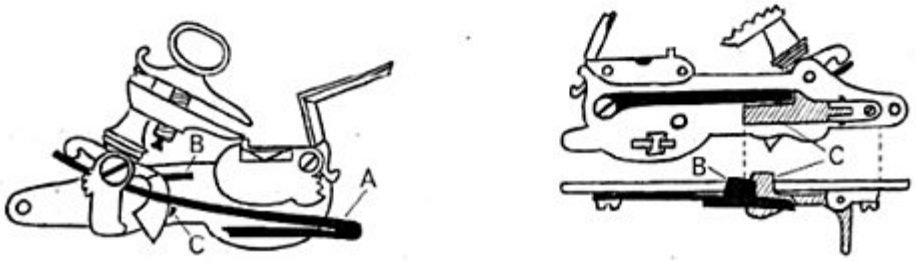
Gun Locks



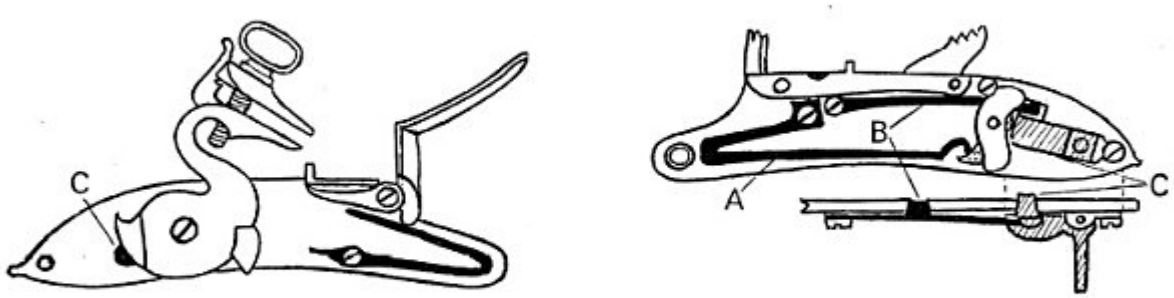
Italian Lock



North African Lock



Gun Locks Fig. 12.3 (f)



Madrid Lock

[147] Pant, G.N. *Studies in Indian Weapons and Warfare*. Delhi, 1970, p. 145.

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[149] Ashdown, C.H. *European Arms and Armour.* Brussels and New York, 1967, p. 27.

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[151] Abul Fazl. *Ain-i-Akbari*, tr. Gladwin, Vol-III, p. 38.

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[154] Pant, G.N., op. cit., quoting from the Valmiki Ramayana, Balakanda, Sarga 22.

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[156] Ashdown, C.H. *European Arms and Armour.* Brussels and New York, 1967. Op. cit.

[157] Pant, G.N., op. cit., p. 137.

[158] Curtius, Q. *Megasthanese*. Vol-VIII, frag XXXIV.

[159] Smith, V.A. *Catalogue of Coins in Indian Museum*. Calcutta.

[160] Gardiner, P. *The Coins of the Greek and Scythian Kings of Bactria and India in the British Museum*.

[161] Pant, G.N., op. cit., pp. 20–21.

[162] The medieval period in Europe covers the period from c. 500 **A.D.** to 1500 **A.D.** But in Indian history it normally covers from 700 **A.D.** to 1700 **A.D.** and is broadly divided into early and late medieval period, the former c. 700 **A.D.** to 1200 A.D. and the latter from c. 1300 to 1700 A.D.

[163] Kautilya. *Arthashastra*. Vachaspathi Gajrola, 1962, pp. 92 and 218.

[164] Pant, G.N., op. cit.

[165] Bernier, F. *Travels in the Mughal Empire*, 1891.

[166] Arrian. *Indica*, Chapter XVI.

[167] Ashdown, C.H. *European Arms and Armour*. Brussels, New York, 1967.

[168] Rapson, E.P. *Cambridge History of India*. Vol-I, p. 328.

[169] Mc Crindle, J.N. *Ancient India*. As described by Magasthensese and Arrian, 1967, Calcutta, p. 71.

[170] Ashdown, C.H. *Europeans Arms and Armour*. Brussels and Brussels, New York, 1967.Op. cit.

[171] Blair, C. *Europeans and American Arms*. London, 1962, p. 33 and 34.

[172] Blair, C., op. cit.

[173] Gay, V. *Glossaire Archaeologique I*, pp. 45–50 (Blair, op. cit.).

[174] Pant, G.N., op. cit., p. 174.

[175] Pant, G.N., op. cit., p. 45 quoting an earlier source on the *Nagarjuna Hill Cave Inscriptions of Avantipuram, Fleet, Corpus Inscriptionum Indicarum*, Col III, 1963.

[176] Blochman. *Ain-i-Akbar.* English translation, 1873.

[177] Abul Fazl. Gladwin, tr. *Ain-i-Akbari*.

[178] Ashdown, C.H. *European Arms and Armour*. Brussels and Brussels, New York, 1967.Op. cit.

[179] Wilkinson, F. *Arms and Armour*. London. 1978, pp. 54–55.

[180] Blair, C., op. cit., pp. 35–37.

[181] Blair, C., op. cit., p12.

[182] Hewit. *Ancient Armour*. Vol-I, p. 326.

[183] Gay, V. *Glossaire I*, pp. 43–46.

[184] Blair, C., op. cit., p. 37.

Chapter 11
System of Ignition

Almost all portable firearms consisted mainly of three major components – the lock, stock and barrel. The lock is basically a mechanism of the arm for igniting the priming powder in the pan. Perhaps it is this component of firearms which was subjected to numerous improvisations during the past six centuries or so. Although gun locks are now broadly classified under some specific types, it is not possible to include some types of locks under any one of these classifications. Such locks were of the transitory period when an old type of lock was on its way out and giving place to the next fully developed form of lock. They invariably incorporated one or the other features of either the old or the new, or both, and so do not fall, strictly speaking under any of the accepted classifications. Some arms historians, therefore, qualify those locks, which conform to the constructional details spelled out by prefixing their nomenclature with the word "true" to distinguish them from the transitory types of locks.

11.1 The Cannon Lock

The powder charge contained in the pyrotechnic, or fire weapon, was normally ignited by setting it alight with a fuse of slow match leading up to it, as is invariably done in the common firecracker (Fig. 11.1(a)). The charge usually consisted of a weak explosive powder as these weapons were basically smoke, flash and noise producers. A few, however, projectiles were discharged without any thought of penetration. It was, therefore, quite convenient to ignite them in this fashion. But when true firearms were developed, the constant endeavor of firearm makers has been to harness the maximum possible amount of the explosive force generated by a charge of

gunpowder and to utilize it effectively to propel the projectile farther and with greater hitting power so that it could penetrate targets. To achieve this, the earliest improvisation made to fire weapons of the tube-type was to make the tube of metal instead of bamboo or tough paper. This tube – the barrel – was made thicker in section at the rear portion – the chamber – and the powder and projectile were loaded in this strengthened part of the barrel. This ensured that the explosive force generated by the hot powder gas when ignited was contained safely within the barrel. It was also necessary to ram down the muzzle of the barrel with a thick and tight wad over the powder charge in the chamber to prevent the powder gas from escaping past the wad and the projectile over it. The chamber had to be modified so that the powder charge within could be ignited safely and effectively. A simple system was ultimately found which met the above requirements, probably by the middle of the fourteenth century.

This system mainly consisted of a hole of small diameter, generally known as touch hole, drilled from the top and through the chamber wall toward the breech end of the barrel. The exposed end of the touch hole, the vent, was usually countersunk to form a shallow depression – the flash pan, priming pan or pan. A few grains of gunpowder – the priming – (normally the same powder used for the main charge) was dropped into the pan. When this priming was fired ignited by the suitable application of means of ignition, it flared and the flash passed through the touch hole and ignited the gunpowder loaded in the chamber.

This system of ignition was the earliest and the simplest and is generally known as the Cannon Lock. Actually the Cannon Lock was not a lock at all, since no mechanism is involved other than the hand and perhaps a suitable handle to hold the means of ignition, such as a tinder firing stick. The shooter, held in the hand a handle to which a lump of smoldering moss was attached, a bit of lighted tinder or a piece of hot iron wire and it was applied to the priming powder at the required moment to fire the piece. This simple

method of ignition was used in almost all types of hand firearms, such as hand guns and hand cannons, until the introduction of the matchlock.

Nevertheless, the system of igniting the priming manually was continued to be used in true cannons up to the last century, hence its name.

11.2 The Hand Gun or the Hand Cannon

Although it is generally accepted that the true firearms were known in Europe by 1326 A.D. (Fig. 11.2(a) to Fig. 11.2(e)), no texts of the fourteenth century are in existence giving description of firearms. Contemporaneous sources deal only with manageability of firearms, and, therefore, great reliance has to be placed on the very few illustrations of the period now available, to get some idea about their general shape and constructional aspects. A few surviving examples of hand guns or hand cannons dateable for the fourteenth century are either excavated pieces from ancient ruins, such as castles and fortresses, and those fished out of the deep seas – relics of sunken vessels. It is, therefore, possible to date them only approximately with the dates of destruction of the concerned ruins, or the dates on which the vessels were sunk. Fortunately, some of these examples bear close resemblance to the illustrations in contemporary works and provide scholars with valuable information, although scanty, about the general trends of development of firearms in their formative years.

The name hand gun (variously mentioned as handgonne, gunnies, vasam scolpi, pot, capita, and testes) first appears in an English bill of 1373–1373 A.D.,for handles to guns and haches, in the manner of spikes. Gay[185] mentions another source of 1383 recording seven reinforced cannons, four of them large and three portable. In 1386, Chamberlain records about sending three hand guns by one Ralph Hutton. The inventory at the Arsenal of Bologna[186], dated 1397, shows an entry: "…VIII solopos de ferro de quibus sunt tress a minibus" (… Eight iron escopottes sloops three of which are hand ones…). Gay[187] also mentions another reference of 1417 to the hand – cannon: "One hand – cannon and Seven hundred arrows…" Here,

the hand cannon is aptly termed as a "Fire Rube," which describes it fairly well.

Early European hand guns were vase-like or pot-shaped (from which the above-mentioned names appear to have been derived) and were so small that they should more appropriately be called hand cannons. They mainly consisted of a crude, but strong, tube – the barrel – of iron, bronze, brass or copper, bound with iron bands to one end of a straight wooden pole – the tiller – so that the piece could be held and fired with reasonable safety. The tiller was often stopped behind the branch end of the barrel to prevent the barrel from slipping back on recoil; obviously, the tiller was neither intended to be the shooter's shoulder nor to be held against the chest or cheek.

Hand gun cannon barrel was invariably short with comparatively large calibers invariably of uniform diameter, although a few examples have clearly defined chambers. The breech end of the barrel was closed to hold a charge of gunpowder. The touch hole was drilled from the top and vertically down through the chamber wall, till it reached the central bore. The top vent of the touch hole was countersunk to form a shallow saucer-shaped depression – the priming pan. Powder was poured into the barrel, this was followed by a lead or stone bullet, and was rammed home one after the other. A few grains of gunpowder were then dropped into a priming pan and the piece was ready for use. To fire the hand cannon the priming in the pan was ignited manually by applying to it a lighted torch, a piece of glowing ember or a piece of hot wire. The powder flared immediately, the resulting flash passed through the touch hole, exploded the main charge in the chamber and dispatched the bullet on its mission.

The earliest depiction of a hand gun (rather hand cannon) is in the form of an illustration in an English manuscript (Milemate) of 1326. India is the only country where stone carvings depict history of handgun use and some – undoubtedly carved before this date – are extant. A significant fact about such stone carvings is that they are all found in old south Indian temples. The Sarangpani (Vishnu) temple of Kumbakonam is one of the most holy

shrines of the Tanjore district. On the left side of the front gate, in the fifth storey from the top (the pagoda, has eleven stories and c. 180 feet in height) is a stone panel of a king sitting on horse-drawn chariot surrounded by his troops. In front of the king carvings of two foot-soldiers holding what are resembling hand guns are seen. This Pagoda is dated to the last quarter of the thirteenth century A.D. In the Tanjore temple, carvings of foot-soldiers with hand guns in their hands on stone pillars opposite the "Swarga Ekadashi Gate." This temple was also most probably built in the period of the Sarangpani temple mentioned above. The Adjijagamnatha temple of Tirupattani on the sea shore near Ramnad in the Madurai district was constructed before the thirteenth century. On the outside of a stone *mandapa* of the ancient temple, carvings of some foot-soldiers carrying hand guns are seen. The soldiers are wearing belts with frills round their waist slippers on their feet and caps on their heads. In a Hindu temple, the *mandapa* is a porch-like structure that leads to the inside of the temple.

The Satastambka *mandapa* (Nitikal *mandapa*) of Kanchipuram temple as its names indicate rests on 100 stone pillars. It was erected by one Lakshmi Kumara Tatacharya or Kotikatnya Tatacharya. In this square-shaped *mandapam*, 12 stone columns face the eastern and western sides, eight columns face the northern and southern sides and the remaining four columns of the north side are leaning from the west. On the solid stone columns carvings of combat between soldiers are seen. One horseman and a foot-soldier aims his hand guns at his enemy. The *mandapa* can be dated to c. 1624. On one of its stone pillars is a figure of a soldier. The Sabkama *mandapa* of the Siva temple in Perur, near Coimbatore, has figures of a soldier with a hand gun.

The first European cannon was a vase-like pot with a hole. This was filled with powder and fired. They gave way to the familiar tubular form, at first with brass and copper, later with iron. Cannon was used in the year c. 1346 at the siege of Falais.

It is not possible to establish whether it was the hand cannon or its larger version – the cannons of bambards – that was introduced first. The general construction, loading and firing of both types of weapons were very similar, and so it is quite probable that they were developed simultaneously. The cannon was mainly developed to replace the cumbersome mechanically operated siege engines for smashing the gates and walls of castles and fortresses. The projectiles used were, heavy balls of stone, iron, brass and lead. Heavy spear-like arrows of the crossbow type of siege engines, often referred to a bolts, quarrels and garrets, were also shot out of early cannons to destroy the enemy of fortifications. Cannons were either fixed in place or dragged on sledges. Hand cannons were mainly weapons of close quarter battles and fired small arrows, lead bullets or pellets.

There are very few surviving examples of European hand cannons of the fourteenth century which could only be dated approximately. Two Italian guns, were perhaps the oldest piece known to arms historians. The first one was of bronze and decorated with a Greek cross and Oak Leaves. It bore the number 1322, believed to be the year of its manufacture. This piece was described by Count de Arco, who owned it at that time, in 1847. This gun is also mentioned by Angelucci[188], a renounced Italian antique firearms scholar of the last century. This gun was unfortunately stolen from the Italian monastery of St. Orsola a Mantua in 1849. The other example, mentioned by Smith[189], is said to be of the early part of the fourteenth century, and is believed to be excavated from the ruins of the ancient Castle of Mount Vernous, in 1341. It was a wrought iron piece having a roughly finished barrel and shaft arrangement. This cannon was also lost.

The oldest surviving example of a European hand cannon is an excavated piece from Loshult (Skane), Sweden, in 1861, and this is held in the National Historical Museum, Stockholm. According to Blair[190], this gun is usually dated to the first half of the fourteenth century as it is very similar in shape to that shown in the Milemete of 1326. This hand cannon is about 30 cm long, vase-shaped, and cast in bronze. The bore tapers from about 36 mm at

the muzzle to about 31 mm near the chamber. The touch hole is drilled vertically from the top and countersunk at the vent to from a shallow pan.

Another surviving example of the fourteenth century is the Tennenberg gun at the German National Museum, Nuremberg. It is also an excavated piece of 1849 from under the ruins of the Castle of Tennenberg, in Hosse, in what remained of a cistern. This castle became a stronghold of notorious bandits in the fourteenth century and as a result it was ultimately razed to the earth in 1399. It is, therefore, presumed that this gun was made before the date of destruction of the castle.

The octagonal barrel of the Tennenberg gun[191] (Fig. 11.3(a) to Fig. 11.3(c)) is socketed at the breech, about 32 cm in total length and weighing about 1.235 kg. The bore diameter at the muzzle of the barrel is about 18 mm and the bore is constricted in front of the chamber to form an internal ridge. When a bullet is rammed down the barrel, after the powder charge and wad, it lodged firmly against this ridge and stopped compressing the powder any further.

Although the gun is devoid of decoration, from its design and construction, some experts were of the opinion that it is of a date later than 1399. However, archeologists have decided the issue by confirming that the piece is dateable to the fourteenth century.

Blackmore[192] and Blair[193] mention another bronze hand cannon recovered from the sea near Morko (Sodermanland), Sweden, now in the National Historical Museum, Stockholm. It is a very fine example of a hand cannon, inscribed and decorated. The total length of the piece is about 19 cm and the caliber at the muzzle is about 20 mm. The barrel is thicker at the chamber in the normal cannon fashion. The breech end of the barrel is socketed to accommodate a wooden tiller. The touch hole is drilled into the chamber from above and countersunk at the top in a shallow squarish priming pan. It is fitted with a hook projecting downward from the barrel, a feature that was to become common in the fifteenth century.

The Morko hand gun bears religious inscriptions: “Maria Plea (Ave Maria Gratin Plena)” and (Fig. 11.4(a) to Fig. 11.4(d)) “HELP.GOT.HELP.UNS.” A small bust of a man wearing a beard, reminiscent of Jesus Christ, is set behind the priming pan, whose hair and beard style indicate that the piece must date from the last quarter of the fourteenth century.

A few examples are not fitted with wooden tillers, instead the breech end of the barrel is elongated by forging to serve the purpose of a tiller. Surviving examples of such all metal hand cannons are held in some European museum, with wavy, spiked or twisted handles. Some examples have handles terminating in a ring or an oval grip. Tejhusmuseet Copenhagen, an example of an iron hand gun, which was excavated at the site of a ruined castle of Vedelspang (South of Schleswig), was constructed in 1416 and destroyed about ten years later. The Vodelspang hand cannon[194] is a precisely dateable example of an all metal hand gun with a rod handle ending in a knob. An iron hook is attached to an iron ring, and the ring is in turn shrunk fitted to the muzzle end of the barrel. The barrel is about 21 cm long and is bored to a caliber of about 18 mm at the muzzle and about 15 mm at the chamber.

A number of hand cannons (Fig. 11.2(a) to Fig. 11.2(e)) of the types described above, particularly of the Tennenberg type, are also extant and displayed in various continental museums. But as these types of hand guns were in use until the end of the fifteenth century, it is rather difficult to date them precisely. For instance, there are hand cannons dating from before the time of firing from the shoulder, in the Historical Museum of the Tower of Pilsen[195], in the German National Museum, Nuremberg[196] in the Berlin Arsenal[197]; in the Museum of Arts and History, Geneva[198], in the Historical Museum, Hamburg and in the Swedish State Historical Museum and the Royal Armoury.

The hand gun with the pole-shaped tiller was in use upto the fifteenth century and during this period two main modifications to the tiller were introduced. First, the breech end of the barrel was socketed or spiked so the

wooden pole, or a haft as it was known by now, could be fitted directly to the barrel without any metal clamps, as was done earlier. Blackmore[199] quotes from an English bill of 1373–1375 for fitting handles to guns and hatches (*ad. Pro helvying viij gonnorum et c hachettoum*) in the manner of pikes (*ad medum pyceys*). The guns referred to are undoubtedly *socketed hand of gyns*.

Blackmore also reproduces a sketch from the Codex Germ. 600, Munich, of c. 1400, in which a hand gunner is holding a socketed hand gun with one hand and a ramrod with the other. Neither a flash pan nor any means of ignition are shown in the sketch and the gun was most probably ignited at the muzzle.

The handles of all metal hand cannons were fashioned in many ways. Apart from the practice of elongating the breech end of the barrel to form the handle, mentioned earlier, the handle was also frequently made as a separate component and then forged to the breech end of the barrel. Sometime later, this handle was modified for mounted use by terminating it as a ring or knob. However, the practice of attaching the gun barrel to a wooden haft with metal clamps was continued throughout the fifteenth century. In the Berne Museum, there are several examples of the fifteenth century hand cannons with cast bronze or wrought iron barrels bound to wooden shafts with iron bands.

The other modification to the tiller, most probably introduced at end of the fourteenth century, consisted of a small metal hook, protruding downward and fitted close to the forward end of the tiller. By about the last quarter of the fourteenth century, this hook was made as an integral part of the barrel, or as an extension of a metal ring shrunk fitted to the muzzle end of the barrel. This hook was placed in a fork of a branch or a stick to act as a recoil stop. It was also useful to support the gun over a parapet of a fortress or castle before firing. According to Blackmore and Blair[200] guns fitted with such hooks were known as Hakenbuchse (hook-guns) in German. But later this word was applied to almost all portable guns of the infantry and was transformed into the English *hackbut or hagbut*, the French *arquebus*. The

Italian *archibugo* and the Spanish *arcabuz*. However, it is also quite probable that names might have also been derived from the Spanish word *haken or harq* (Hak), meaning a stick used to support the gun barrel of such long-barreled guns.

By the end of the century some major improvisations were made to the hand gun barrel. It was now forged in one piece with the breech end closed. Henceforth, hand guns were fitted with longer barrels, often projecting beyond the forestock. The simple method of attaching a barrel by means of a socket or spike was discontinued and, instead, iron rings nailed to the stock were used.

Until about c. 1250, the gunpowder, then generally known as black powder or simply powder, contained 41% saltpeter and 29.4% each of sulfur and charcoal. By about c. 1350, it was modified by a new formula, 66.7% saltpeter, 22.2% charcoal and 11.1% sulfur. This formula was adopted throughout the period of use of cannon lock hand firearms. The ingredients of gunpowder were powdered finely and carried in separate containers and were mixed together as and when required. It was only much later that gunpowder was kept ready mixed. However, the priming powder was normally carried in a separate container ready mixed and the ingredients, same as those of gunpowder, were very finely ground. The rate of combustion of gunpowder depended mainly on the percentage of saltpeter it contained – the larger the saltpeter content, the faster was the combustion. However, fast burning powders could not be used in hand guns and hand cannons as the barrels could not withstand the high pressures developed in the chamber.

The quality of gunpowder used in hand firearms was poor as the processes of glazing and granulating the powder were not yet introduced. Although the method of corning gunpowder was as early as 1412, it was not generally adopted in the fifteenth century. The muzzle velocity and muzzle energy of a bullet projectile depended mainly on the rate of combustion of the gunpowder used –that is, on pressure developed by the hot gases generated

during combustion of the powder charge in the chamber. An effective wad was, therefore, necessary between the powder charge and the projectile, not only to prevent the powder gases from escaping past the wadding, but also to ensure that the pressure generated by the powder gases is maintained uniformly until the projectile leaves the muzzle of the gun barrel.

A shooter normally held his gun with one hand and a means of ignition with the other. It was, therefore, not possible for him to hold the gun steadily for proper aiming and to apply the ignition precisely at the desired moment. As the gun stock was nearly straight. It was neither possible for him to fire the piece with the butt to the shoulder nor to rest the stock against his chest or check. The gun could only be mounted with the stock resting over his shoulder or with the butt stock tucked under his arm. Perhaps the longer version of the hand gun needed two men to handle and fire, one to hold the piece and aim it, and the other to apply the ignition at the required moment. Blackmore[201] mentions an illustration of c. 1430 in which a group of sportsman and hand gunners, both firing incendiary arrows, are depicted. Toward the end of the fifteenth century, after the introduction of long-barreled hand guns, a rudimentary form of shoulder stock was being tried, and on an illustration in the military works of Vegetius and Valturius, c. 1460–1470, hand gunners confidently firing from ships and towers of castles, with their guns mounted to shoulders, are shown. Another sketch reproduced by Blackmore[202] from a painting of c. 1502, in the German National Museum, Nuremberg, showing hand gunners carrying hand guns, stocked with butts of manageable proportion, with one hand and tinder firing sticks with the other.

It was very difficult for a hand gunner to keep the material he used for igniting his piece, such as a lump of smoldering moss or a piece of tinder, smoldering continuously. And when he used a piece of hot wire to ignite the priming he had to carry some means of heating the wire every time he wished to fire the piece. This method of ignition was, therefore, very unsatisfactory, particularly under battle conditions and inclement weather.

To overcome this drawback, a better means of ignition – the so-called slowmatch – was introduced.

Peterson[203] records a description of the slowmatch mentioned by Surirey de Saint in his Memories d'Artillerie (1697) to say that it was a long cord or rope-like twist made from hemp or flax tow. The tow is the waste arising while the long fibers of them were separated during combing. The tow was separated into three strands of medium width and each covered separately with pure hemp to hold the tow in shape. The cord so forward is then washed, glazed and tightened. A length of such cord was soaked in a saturated solution of saltpeter and less of wine and dried thoroughly. It would then burn at a rate of about four to five inches an hour. The lighted tip of the match should make a good and hard coal, which finished in a point that could stand up to being pushed against the priming powder. By diluting the saltpeter solution, it was also possible to reduce the rate of burning to about 12 cm per hour.

The hand gunner, henceforth, carried a piece of slowmatch with him for igniting the priming. He lit it at both ends so that when one end got extinguished, it could be relit with the other glowing end of the slowmatch. By this time other accessories such as a bullet mold (mouldes vacate formule), an iron ramrod (drivelles ferri), etc., were already introduced. With these improvisations, both the civilian sportsmen and the soldier considered the utility of the hand gun for sports and war, respectively.

However, on the battlefield, even after the introduction of the hand gun, the much cherished longbow still reigned supreme. Although a longbowman had to be strong and had to practice regularly at the butt to maintain his proficiency as well as to keep himself ready for war, the longbow was the darling of the infantryman. The other contemporary weapon of the day – the crossbow – required lesser strength and skill than needed to use the longbow. But it was more expensive and very complex in construction. The rate of fire of the longbow was much greater than that of the crossbow. The range of the former was about 200 m. The range of the crossbow was about

half of this. Although both these weapons discharged one arrow at a time, their rate of fire was much greater than that of the contemporary hand gun.

Although the hand gun of the fifteenth century was crude, clumsy, heavy, awkward to use and inaccurate when compared to the longbow and the crossbow, it had the advantage of easy loading to operate. The skill involved in its use was to measure and pour down the barrel the correct measure of gunpowder, ram home either a bullet or a measure of shot and point it in the general direction of the enemy before applying the match to the priming. It was, therefore, a very simple weapon to use and the time and effort required to train even a peasant was far less than that needed to train with the longbow or crossbow. The other important advantage of the hand gun was a psychological one, in that when fired from close quarters, the loud bang followed by a cluster of shot caused fear to the enemy and panic to his mount. In spite of these advantages, more than a century elapsed before the hand gun could displace the longbow and the crossbow in the hands of a combatant. Ultimately, improved versions of the simple tube charged with crude gunpowder drastically affected the entire mode and conduct of warfare, influenced the history of the entire world and changed the geographical borders of nations from century to century.

Cannon lock hand firearms were first introduced in to the European armies by the end of the fourteenth century, although they were inaccurate and unreliable, and their rate of fire was much less than that of the military longbow and crossbow. The main virtue of a hand gun was that it could produce a volley of fire that could be disastrous to the lavishly armored soldier.

Gradually, firearms began to oust the old, well-tried and trusted weapons and armor. The nation to explore the military applications of hand guns on a large scale was France. The French army was equipped with firearms in the fifteenth century and they gained a final victory in the Hundred Years War against England. The English, however, clung to their longbows, as their infantry weapon, until the late sixteenth century, although firearms ofthe

matchlock variety were introduced to a limited extent in the British army in the fifteenth century earlier and were used by Edward VI at Ravenspur in 1471. The yeomen of the English Guards were armed with matchlock guns by about 1545.

Introduction of firearms for the fighting forces ushered in radical changes in the organization, command and control of the armies. Before the adaptation of firearms in warfare, many nobles and feudal lords could raise small armies from their tenants of employees, arm them with longbows and maintain them as part time forces.

When the soldier was armed with a hand gun, however, the cost of raising an army of hand gunners to provide them with powder and bail for practice and engagements became very high. It was also necessary to maintain and train an army on a more permanent basis and the result was that only kings could afford to raise, equip, train and maintain armies of hand gunners. Consequently, the nobles lost their strength and the king became powerful at their expense. He was also able to oust the ambitious or rebellious nobles with the powerful and well-trained army under his direct command.

Introduction of firearms also radically affected some organizational, command and control, and military tactics of both defensive and offensive operations of armed forces. First, the traditional castles and forts, built primarily as strongly defended localities, were know rendered useless as no walls or gates could withstand shelling from the crudest of cannon. Second, a metal bullet fired from a hand gun at close range could penetrate all but the best-made body armor of a soldier or cavalier. This factor alone was mainly responsible for rendering the body armor obsolete in Europe by the seventeenth century.

11.3 Matchlock

Cannon lock band guns of the fourteenth century had some inherent drawbacks, and the most obvious one was that a shooter could hold it only with our hand as he held the match with the other (Fig. 11.5(a) to Fig.

11.5(i)). He could, therefore, neither hold the gun steadily nor aim with it properly. It was also difficult for him to apply the match exactly at the required moment to fire the piece. Naturally, the first improvisation to the cannon lock was to attach a suitable mechanism to hold and operate the match. An unknown inventor, possibly a German, found a solution, probably in the first decade of the fifteenth century, and a simple mechanism – the matchlock – was devised.

The earliest version of the matchlock was in fact a simple modification to the cannon lock. It consisted of a C-shaped metal lever pivoted at its lever end to the side of the stock. The top end of this lever was split so that a piece of slowmatch could be fixed at the top. When the lever was pushed forward the match end of it dipped into the pan. A metal clamp was also attached from above the stock, and near the pan, to hold another piece of match in a stationary position.

To fire the gun, it was loaded in the normal cannon fashion and the match fitted to the clamp on the stocked was lit. The lever to which the slowmatch was fitted was then pushed forward with the thumb or forefinger of the shooter's right hand until the top end of the match touched the glowing end of the match fitted to the clamp on the stock. When the tip of the match attached to the lever started shouldering, this lever was pushed further forward until it dipped into the pan flared and discharged the gun at about the time the shooter wished.

Blackmore[204] and Blair[205] mentioned that the earliest painting of the matchlock appears in a German manuscript of 1411, Codex Germ. 3069, in the Austrian National Library, Vienna. This illustration shows a hand gun to which a simple Z-shaped lever – the serpentine or match holder – is pivoted centrally to the left side of the pole-shaped stock, or let in to a slot cut in the stock. A piece of tinder, or some such means of ignition, is attached at the tip of the upper arm – the match end. The lever arm of the serpentine is elongated to form the trigger. It could be clearly seen that the serpentine was merely a one-piece cock and trigger.

Pressure applied with finger tips on the part of the serpentine swung its match end forward and down into the pan. Blackmore also mentions another vigenette in the decoration of a Froissart Ms., in the Breslau City Library, of 1468. The illustration shows a centaur firing a matchlock similar to the one described above. This type of matchlock is shown and illustrated until the last quarter of the fifteenth century and no surviving examples exist. However, this type of lock does not strictly come under the classification of true matchlock and could, therefore, be regarded as a transitory lock between the cannon lock and true matchlock.

11.4 European Matchlock

The characteristic features of a true matchlock are as follows: first, a separate match holder, or the cock, pivoted independently to a metal plate, generally known as the lock-plate, or let into a recess cut into the stock; second, a button lever or leaf trigger operate the cock and last, a system of levers, springs tumblers and sears to convert the movement of the trigger to activate the cock and dip the lighted end of the match into the pan, and then restore the cock back to its original position (Fig. 11.6(a) to Fig. 11.6(e)).

11.5 Merz Matchlock

Martin Merz, of Germany, is generally credited with the invention of the first true matchlock – the Merz matchlock (Fig. 11.7(a) to Fig. 11.7(f)). It is described in a German MS., Codex Germanics 599 of 1475, in the Staatsbibliothek, Munich. The lock mechanism consisted mainly of a cock, a button or a lever, trigger, sear lever, a spring and a tumbler, sometime later, a modified form of this lock was produced by an English gunsmith, Cornelius Jhonson, incorporating a cock, a sear, two flat springs and a tumbler.

Basically, the early European matchlock consisted of cock – the match holder – pivoted to outside the lock-plate which was screwed or nailed to a recessed portion at the side of the stock. A slotted tumbler was fitted to the pivoted end of the cock. A sear lever was also pivoted to the inside of the lock-plate with one end fitted to the slotted tumbler end and the other end

attached to a long extension piece – the trigger. A leaf spring mounted below the sear lever exerted an upward pressure on the arm attached to the tumbler and kept the match end of the cock out of the pan. When an upward pressure is applied to the trigger arm, the end of the sear lever attached to it moved up the arm and the other end of it moved down against the tension of the spring and caused the match end of the cock to dip into the pan. When the pressure on the trigger arm is released, the spring returned the sear lever to the original position along with the cock, some illustrations in German MSS. The last quarter of the fifteenth century shows these locks but no actual example dating from before the fifteenth century is known to survive.

In the last quarter of the sixteenth century, the European matchlock described two distinct brands of development resulting in the introduction of two specific types of matchlocks – the snap matchlock and sear matchlock. In both these types of locks, the one piece serpentine was discarded and in its place a short curved lever – the cock – and a form of release mechanism to dip the match end of it into the pan were substituted. The cock was pivoted independently to a metal plate the lock-plate screwed to the recessed part on the right hand side of the stock. The cock was normally pivoted externally to the lock-plate, while the rest of the lock component was either fitted on the enclosed side of the lock-plate or simply let into a slot cut through the stock.

11.6 The Snap Matchlock

The snap matchlock (Fig. 11.8(a) to Fig. 11.8(d)), also known as the light snapping lock in Germany where it was introduced first, started developing by the third quarter of the fifteenth century. Early versions of it are illustrated in the Arsenal Book of Emperor Maximilian of Savaria upto about 1520. Peterson[206] records another illustration in the Codex Monacensis 222 of Munich, datingc. 1500, which shows a snap matchlock with a cock but no trigger. The shooter is firing the gun from his shoulder with his left hand placed just below the cock end of the position of his finger

of the hand indicating that they are about to press some part of the gun close to the lock-plate – some sort of a lock-releasing mechanism.

A snap matchlock normally consisted of a long, thin cock with a tubular tinder holder fitted at the end. The holder was pressed down into the pan by a week spring, known as the cock springing. On the enclosed side of the lock-plate, a springy lever was anchored by its forward end. This lever carried a stud – the sear – which it held pressed outward through a hole in the lock-plate below the base of the cock. At the other end of the lever was fitted a button which protruded out of the rear of the lock-plate, or projected into a recess at the side of the butt behind the lock-plate. The base of the cock had an extension projecting either forward or backward. When it pointed forward, it was called the toe, and when it pointed the other way it was known as the heel, of the cock. When the cock was pulled fully back, against the action of the cock spring the stud, or sear, on the springy lever caught the cock either by its toe or heel, as the case was, and kept the top end of the cock out of the pan. When the button on the springy lever was pressed it retracted and released the cock to snap forward into the pan by the action of the cock spring.

Surviving examples of snap matchlock guns are indeed very rare. Perhaps the two *arquebuses* displayed in the Basle Historical Museum (inventory numbers 1905, 4498; and 1905, 4498(a)) are the best examples. In these *arquebases*, the lock is fitted in front of the pan and a button trigger located well forward, perhaps to enable the shooter to operate the button with a finger tip of the left hand supporting the barrel. The button, actually the head of a rod attached to a trip lever, which when pressed disengaged and released the cock. The cock is fitted with a tubular tinder holder. Locks of this type appear to have been popular only for a brief period in the early part of the sixteenth century.

When a snap matchlock is fitted with a tubular tinder holder, the lock is generally known as a tinder lock, However, it is also possible to fit into the holder a short length of slowmatch instead of a piece of tinder. The main

advantage of using tinder was that it could be lighted just before a shooter went into action and the glow of the lighted tinder was shielded by the holder more effectively. By using a piece of tinder, the long piece of match dangling from the cock was also eliminated.

Blackmore[207], quoting an earlier source[208] mentions about a group of European snap-matchlocks, examples of which could be dated from 1570 to 1635, which incorporate an early version of what is now called a set, or hair trigger mechanism. This mechanism contained a spring-activated intermediary link between the trigger and sear. The cock spring, also known as the mainspring, is attached to the inside of the lock-plate and works on a tumbler. The trigger is also pivoted to the inside enclosed side of the lock-plate and the remaining parts of the lock mechanism are attached to a base plate, which lies along the bottom of the lock-plate and at right angles to it. In addition to the normal sear lever, an intermediate lever is also incorporated with a separate spring controlling both these levers. One end of the main sear lever engages the tumbler and the other end is pressed toward the lock-plate by one the intermediate lever. The other end (pointed) of the intermediate lever engages the stem of the trigger. In some examples, the button trigger is replaced by a small trigger.

To cock the lock, the intermediate lever is pulled, or pushed, away from the sear lever by means of a cord, or a button, respectively, until the pivoted end is held by the rotating trigger stem. The cock could be then pulled back until the sear catches the tumbler. When the trigger is pulled, the pointed end of the intermediate lever is withdrawn and its other end hits the sear and causes it to release the tumbler and dipped the cock into the pan. The cock is fitted with a tubular tinder holder and faces toward the shooter.

The examples at Basle are fitted with oblong German butt designed to be held against the shooter's cheek, as was customary with German shooters of the period. The lower edge of the butt was shaped to form three arches to accommodate the three fingers of the shooter's grip, or right, hand. Subsequently, when a diminutive form of leaf trigger was fitted in the place

of the usual button trigger, the underside of the butt was shaped into a beak-like projection to serve as a partial trigger guard. These firearms are fitted with rifled barrels and sights and were most probably made for target shooting. The early rear sights were usually cylindrical tubes fitted to the stock from above and near the breach end of the barrel. The shooter peeped through the tube to align the rifle with the target.

The cock was normally split longitudinally at the top to form a pair of jaws which could be squeezed together to hold the slow match. But soon the java was operated by a thumbscrew. However, on some snap-matchlocks the top end of the cock merely provided with an eyelet through which the match could be simply threaded. The length of the match was regulated, before firing, by a trial with the pan empty so that when the cock was lowered the lighted end of the match dipped into the middle of the pan – the process was known by the term "proportioning" the match.

The snap matchlock was in use in Europe up to the second quarter of the sixteenth century and occasionally up to the beginning of the next century. However, by this time the conventional type of leaf trigger was invariably fitted in place of the button trigger. Some arms historians, therefore, classify such snap-matchlocks fitted with the conventional type of leaf triggers as trigger, or ticker, locks and those fitted with button triggers as button locks.

11.7 The Sear Matchlock

The characteristic feature of the so-called sear matchlock, or sear ock, is that the cock spring operated in the opposite direction to that of the snap matchlock and held the cock up and away from the pan (Fig. 11.9(a) to Fig. 11.9(e)).A sear lever is pivoted vertically on the enclosed side of the lock-plate with one end engaging a tumbler (often slotted) mounted on the cock spindle and the end of it linked to a long underlever – the trigger similar to that of a crossbow – extending underneath the stock and following the bottom line of the butt. The sear lever is pressed down by a spring – the mainspring. The cock is pivoted to the front end of the lock-plate. A spring

generally known as the mainspring exerted an upward pressure on the sear lever (tumbler end) and kept the cock out of the pan. When a gentle upward pressure is applied to the under lever, against the tension of the mainspring the tumbler moved along with the cock spindle and swung the cock forward and down toward the firer, and dipped the match attached to the cock into the pan. When the under lever is released, the mainspring returned the cock to the original position. This type of matchlock is shown in Codex Germ. 597 dated 1475.

Although the mechanism of the sear matchlock was simple, it was prone to accidental discharge when the long under lever was jerked inadvertently. To eliminate this, the lock was modified by the beginning of the seventeenth century into a form generally known as the trigger lock, or tricker lock. In this version, the long under lever was replaced by a small curved trigger, nearly similar to the modern one. This trigger was accommodated separately in a recess under the stock and a rudimentary form of trigger guard, consisting of an angular or semicircular metal strip was screwed or nailed to the stock, encircling the trigger.

In the second half of the seventeenth century, the lock-plate was shaped like the one fitted to flintlocks, and another plate similar to it was fitted to the opposite side of the stock, which became handy to decorate the gun. In some advanced types of sear matchlock, a sliding pan cover was fitted which opened the flash pan automatically when the under lever was pressed and the cover returned to the closed position when the lever was released.

The sear matchlock was fitted to European military long guns up to the end of the seventeenth century, mainly because its mechanism was simple, cheap and easy to maintain under field conditions. In this form, the sear matchlock was used, at least for military purposes, until the eighteenth century. The characteristic feature of the majority of military matchlocks guns was the undecorated, or at the most sparsely decorated, stocks and smooth lock-plates.

A modified version of the sear matchlock was the pressure lock. It was probably introduced first in Germany as early as 1521. It consisted of a long under lever, extending backward along the bottom line of the stock, a sear, a sear spring, a match holder or cock and a cam or tumbler. When the under lever was pressed, the cam mounted on the cock spindle rotated and swung the cock forward and down and dipped the smoldering tip of the match into the pan. When the under lever was released, the sear spring pulled up the cock to its original position. The advantage of the long under lever was that it could be operated by the hand holding the stock, to give better control of the gun. The sear spring was fitted so that once pressure on the under lever was released, the cock sprang back to its original position clear of the pan.

The sear matchlock became very popular and is used until today in some parts of Asia and Africa. In India, unlike most other countries of the Far Fast, the sear lock was used extensively but they were fitted internally within the butt stock. The under lever is shortened and the bottom of it is flattened to form the trigger. The cock is connected to the sear lever by a separate link. All these components work in a vertical slot cut through the stock and are pivoted with transverse pins. The entire lock is lot into the stock with only the extremities of the cock and trigger exposed. The cock, or serpentine, moved forward, away from the shooter, activated by pressure on the blade trigger which was pushed up into a recess in the stock. There was no trigger guard. This type of matchlock is typical of those used in the northeastern regions of Indian much as Persia, Afghanistan, Turkey, Bhutan and their neighbors.

11.8 Development of Matchlock Firearms

Soon after the introduction of the matchlock, the gun itself was subjected to many modifications. In the third quarter of the fifteenth century, the position of the touch hole was changed from the top to the side of the chamber. Consequently it also became necessary to fit a small metal pan, generally known as the priming pan, or flashpan or simply pan, just below the vent of the touch hole to hold the priming. Probably by the end of the

century the pan was fitted with a hinged cover, commonly known as the pan cover, when the pan cover was shut manually, the priming inside the pan contained without spilling and was also protected from exposure to wind and weather. A small vertical screen was also sometimes fitted before the pan to shield the shooter's eyes against the flash of the priming powder. Incidentally, the pan cover was perhaps the first safety devise introduced to prevent accidental firing of the piece as the priming could not be ignited until the pan cover was pushed open manually before pressing the trigger. Nevertheless, the vertically drilled touch hole, with the vent and flat pan above the chamber, was in use until the middle of the sixteenth century particularly on cannons and heavy wall *harquebuses* designed to be fired from fixed mounts.

With the touch hole drilled at the side, the aiming line of the gun was free of obstructions such as the pan and the cock. The instruction of the pan cover enabled the shooter to carry the gun out doors after loading and priming even in inclement weather. For the first time, sportsmen started considering the usefulness of this new weapon for killing game for the pot. When the gun was loaded with lead pellets, instead of the usual bullet, the gun was more effective than the longbow or crossbow for hunting.

Along with the modifications to the touch hole, priming pan and the cock, certain major improvisations were made to the barrel itself. In the fourteenth century, hand gun barrels were of brass or bronze and were cast by founders. Wrought iron barrels were, however, forged by blacksmiths. The coarse gunpowder, then in use, burned at a slow rate and, therefore, necessitated long barrels to ensure complete combustion of the powder before the bullet left the barrel. By adopting the simple casting or forging techniques, it was not possible to make long barrels and so new techniques were developed by means of which the longer barrel could be made.

From about 1870, barrels were sometimes made of several pieces of solid iron rods each drilled centrally with a hole slightly smaller in diameter than

the required caliber of the finished barrel. These pieces were then forged together, cut to size and the bore finished to the correct diameter.

In the fifteenth century, the barrel of the matchlock gun was normally made into an open tube and was closed at the rear with a plug. As the powder exploded in the breech end of the barrel, the breech end of it was normally made thicker than the rest of the barrel and was usually octagonal in section up to about one-third of its length from the breech end. After this, it gradually became circular up to muzzle end. This process enabled forging of iron barrels than those used for cannon lock hand guns. Probably due to this advantage brass and bronze barrels went out of use by the end of the fifteenth century. They were used occasionally for pistols.

One of the early techniques to make long barrels was the built-up method, that is, a flat strip of metal iron of suitable thickness was bent round a mandrill to form a rough tube and then the seam was welded together by forging. They were then hammered until it became indistinguishable. The resulting tube was then cut to size, bored and filed into shape to form the barrel. It was then reinforced with longitudinal slate held together with iron rings shrunk fitted at regular intervals. By this method, it was possible to make long barrels. Along with the barrel the guns lock was also modified considerably. Although the pole shape of the cannon lock hand gun was far from satisfactory, it was also fitted to early matchlock guns up to almost the third quarter of the fifteenth century. It is not very clear as to when the stock was modified to fire from the shoulder; butt existing evidence indicates that it was done by the last quarter of the fifteenth century. Peterson[209] records that an inventory of the Arsenal of Landshut[210], dated 1485, shows a hand cannon fitted with a long stock and captioned: "*Altere Handpuchsen*." Another picture shows *arquebuses*, the stock supporting the barrel, and a butt, which, although admittedly crude, nevertheless merits the name. The inscription is *Handpichsen so in Kassten sein*. It is quite obvious that by this period matchlock guns were fired from the shoulder by modifying the gunstock.

With the introduction of the matchlock, it was now possible to hold the gun with both hand to mount it to the shoulder or chest to aim and to fire. The natural trend was, therefore, to develop a stock which could be conveniently held against the shooter's shoulder or chest, or with the butt pressed against his cheek. The new type of butt – the oblong butt – was introduced and it appears so frequently in the contemporary illustrations of the land shut soldiers that it has come to be known as the land shut stock. Some illustrations of the sixteenth century (1520) show Maximilian soldiers using such guns fitted with such stocks up to 1520.

The long barrels made were fitted with the new oblong butted stock with the muzzle end of the barrel often projecting out of the forestock. Luge (barrel-tangs) were fitted underneath the barrel tube which fitted into corresponding slots in the stock, and each lug was fitted securely into a corresponding groove in the stock with a transverse pin. The necessity to clamp the barrel and stock with metal bands was thus eliminated.

To load such long-barreled guns, the power was poured down the barrel through the muzzle, followed by a tight wad and then a fairy loose lead ball – the bullet. The bullet about 12 ounce (twelve balls weighing about 16 ounces) and was about 2 to 1 inch in diameter. To ram down the powder and wad and to push down the ball well down over the powder a ramrod or a scouring stick was carried with the gun. It was normally housed in a channel cut in the stock beneath the barrel and could be drawn out when needed and returned to its slot after use.

A powder flask, or powder horn, contained a quantity of black powder, and a built-in semiautomatic measuring arrangement. In a typical version, the nozzle of the flask was closed with a finger and the flask was inverted. A lever was then pressed to allow the powder to run and fill up the space between the finger and the cutoff plate inside the nozzle. The lever was then released to close the cutoff plate. When the flask was righted, powder just enough for one charge was held in the nozzle ready to be poured down the barrel.

Later, paper cartridges were used by musketeers. They were made of thick paper rolled into a tube and closed at one end. The correct charge of powder and one lead ball was placed in each tube and the other end was twisted up to retain the contents. To lead a paper cartridge, the musketeer bit or tore off the twisted end of the tube and poured a small quantity of the powder into the flash pan and then tipped the rest down the barrel. Next he dropped the ball, along with the paper tube in which it was still held, down the barrel and ramrod home into the breach.

A matchlock had to carry a number of accessories such as spare lengths of match, often carried inside the hat or tucked into the belt; a small container which held the priming powder; probably a second larger flask to hold the main supply of powder; a leather pouch containing bullets; a ramrod for loading; a pricker for clearing the vent; flint and steel to light the match and measuring cups to dispense the correct quantities of powder and shot. Later many matchlock men carried a bandolier with a set of about dozen bottle (small flasks) made of wood, horn or tin, suspended on cords from his cross belt. Each bottle contains a premeasured quantity of powder for one load. To load the gun, the shooter removed the stopper of one of the bottles, poured its contents down the barrel followed by a lead bullet (the ball), which he carried in a bag suspended from the belt.

11.9 European Matchlock Firearms

Nomenclature of long guns of the matchlock variety depended to a large extent on the length of their barrels, bore diameter and the manner they were used or mounted (Fig. 11.6(a) to Fig. 11.6(e)). Among these the *arquebus* was the most common type of military firearm from the second half of the sixteenth century. This name was derived from the German word *hakenouschse*, meaning a hooked gun, which was originally applied to hand guns fitted with hooks as recoil stops. However, by the middle of the sixteenth century this name was applied to almost all potable guns of the infantry, and was transformed to *hacbut* or in English, *harquebus* in French, *archibugo* in Italian and *arcabuz* in Spanish. By the end of the fifteenth

century, *arquebuses* were made throughout Spain, particularly in Biscay and Malaga.

A smaller version of the *harquebus*, commonly known as the half-hagy or demi-hake, was probably a *harquebus* modified for mounted use. In 1542, these hal-sezes were issued to the French cavalry, and the English-mounted troops were also armed with these Shortte gunny's soon after.

In the second quarter of the sixteenth century, the longest version of the *harquebus* was mentioned as *arquebus* a'crock or hagbut a'crock, which is now generally classified as wall guns. It is also frequently made during this period to *hacbushes* with frames or *hagbushes* of iron on trundles. Obviously, these firearms were long *harquebuses* mounted on fixed mounts, or supports, and were used for static roles such as defense of forts, castles and towns. They were also mounted on animal-drawn carriages and used as light mobile artillery pieces.

In the second half of the sixteenth century, a new nomenclature for long guns came into general use, such as the musket, bastard musket and a new version of the *harquebus*. Now the *harquebus* became the smallest of the three, size-wise – with its overall length reduced to three feet, barrel cut down to two feet six inches and a bore of seventeen gauges. This reduction in size was probably made to adopt it for firing without the aid of a rest, and also for use of the cavalry.

The musket (which was actually a small, matchlock hand cannon with a 1" bore) was undoubtedly the most formidable and universally popular military portable firearm of the sixteenth and seventeenth centuries. The origin of the word musket is uncertain, but it was most probably from the Italian word moschetto, which meant a sparrow hawk. It is first mentioned in a Naples inventory of 1499.

The musket came into general use in the second half of the sixteenth century and differed from the old *harquebus* in that it was longer and heavier. The Spaniard was the first to realize the usefulness of the musket

and to adopt it for military use. They used it extensively during the first few years of the war against the free Netherlands, the third quarter of the sixteenth century. Peterson[211] records that at Pavia, in 1525, six or seven hundred Spanish *arquobusiers* enfiladed the flank of Charles I's cavalry, and thereby ensured the defeat and capture of the French king. In c. 1600, the Spanish *arcabus* became the portable shoulder weapon of the Spanish army. It weighed about 25 kg, required two men to load it, and could only be fired with the barrel supported by a rest.

It is also believed that the musket was first used by the Italians in the battle of Chiara in 1521, and was described as: "Lighter than the arquebus a croc, but still heavy enough to need a support while firing."

The musket was fitted with a long and sturdy wooden stock with more or less straight butt which could be more conveniently fit against the shooter's shoulder instead of his chest or cheek. This type of butt stock was probably developed in 1570–1580 and according to Peterson[212], it was the Duke of Alba who first realized the military importance of musket stock. The musket itself had a long barrel, about four feet long, and was bored to fire a bullet about 0.75 inches in diameter. It had an effective range of less than 100m. And a rate of fire of about one shot every two minutes.

The musket was so heavy that it was difficult to hold it steadily and to take effective aim without some support. Therefore, every musketeer of the sixteenth and seventeenth centuries carried a light rest, which was usually a stick of ash with a U-shaped metal arm at the top end. The other pointed end of the rest was pushed into the ground and the musket was placed in the U at the other end to support the barrel of the musket while aiming and firing.

France and Spain were the chief military rivals in the sixteenth century and the Spanish army soon out stripped the French in military skills. The Spanish close-packed brigades of pikemen and musketeers became the terror of Europe, and their artillery was the most efficient one. Following the

defeat of the Moors in Spain in 1492, Spanish adventures sought action farther afield, and it was largely the possession of firearm and horses that enabled Cortez to conquer Aztec Mexico to Fizarru to subject Inca Peru at the head of only a few score men. In the seventeenth century, armed with the musket, the Ottoman army, Turkish Ottoman tribes, attempted the last expansionist thrust toward eastern Europe.

Gustavus Adolphus, king of Sweden, led the way in forming the first truly modern army and to reinforce the artillery. But it was the French that became the mistress of Europe and by 1691, Louis XIV had over 400,000 men under arms. As a result, Boutbon France enjoyed fifty years of almost continuous military successes on land warfare.

The musket became so successful in the Spanish campaigns that it was soon adapted by almost all European nations by the end of the sixteenth century. In the last quarter of this century, the British military musket was standardized with an overall length of five feet two inches, barrel length of four feet and a caliber of twelve gauge, about 20 mm. A bullet fired from it could pierce normal body armor at a distance of about 100 m. Towers and fortresses could no more provide adequate protection against enemy bullets. Squat embankments and shallow trenches were enough to provide protection from enemy fire.

The bastard musket was of the same caliber as the musket but its barrel was shorter. It was fitted with either the shoulder butt, of the Spanish type, or the crooked chest butt, of the French type. Another type of long gun was the caliver. This name was an anglicized form of the French word caliber, and first appears in an inventory of 1568 referring to: "*Kalyvers, hand gunnies*, flaska etc." It is said to be derived from the phrase "*Harquebuse de calibre de Nousieur le Price*," which indicated that a weapon of standard bore was ordered for use by the French Catholic Army before the Battle of Montcontour in 1569. The caliver was described by Sir John Smyth as: "Only a haquebuse, saving that it is greater circuit or bullet than the other is of." In England, however, by 1601, the caliver used by the army was the smallest of

the three firearms, fired from the shoulder – the musket – and the bastard muskets were longer, heavier and had bigger bores.

According to Blackmore[213], the caliver was nearly of the same size of the bastard musket, but light enough to be fired without a rest. The standard caliver of the seventeenth century was about four feet and six inches in overall length, fitted with a barrel of about three fest three inches long and bored to about 10 to 11 gauge, getting 20 or 30 shots from a pound of powder.

The other rarely mentioned long guns are the currier and the culverin. The former was probably of a size between the musket and caliver, both in barrel length and bore diameter. The culverin was of medium caliber with a very long barrel. The name calverin, meaning fire mouth, was probably given to it as the muzzle end of its barrel was normally fashioned to resemble the head of a serpent.

Apart from the above-mentioned portable shoulder matchlock firearms of the infantry, a special class of guns, generally known as swivel guns, were in use. A swivel gun may be any gun, including a musket, rifle or blunderbuss, weighing above twelve pounds or more, fitted with a yoke or swivel, strong enough to withstand the recoil of the gun, for mounting the piece.

Although up to the seventeenth century both land and sea service guns fitted with a yoke or swivel were classified as swivel guns, during the eighteenth and nineteenth centuries, the ones for land service were generally known as “wall pieces” or “rampart pieces,” “rifle-amuseter muckets” and “repeater muskets.”

A swivel gun was usually a small cannon, the trunnions of which are fixed in an iron yoke so that they can move freely in the yoke and permit the barrel to be elevated of depressed in aiming. The lower part of the yoke – the pivot – fits on to a hole drilled in timber as that the gun can be swung in any direction and aimed easily.

Peterson[214], quotes Lallemand[215] and describes the guns as intermediate between cannon and small arms as demi cannon: "I have given this name to those firearms that have perhaps least relation to pieces of cannon, than to the cannon." The *harquebus* on a swivel, the rampart gun and the repeating musket of the Americans belong to this class.

The *harquebus*, which nearly resembles the *amoretto* of Marshal Saxo, had a barrel-like musket, but it was naked, longer and more reinforced and the ball weighed half a pound or more and its range at a certain elevation was 1,000 yards. This weapon was mounted upon a wooden frame, and had a handle fixed to the breech, to point it by. It is no longer used, but might as well, as the rampart gun, be employed in mountain warfare.

The rampart gun, or wall piece is a large musket that was anciently used in the defense of fortresses. Its barrel is 5½ or 6 feet long: its ball from 10 to 14 to the pound; its horizontal range 450 yards; it weighs about 50 pounds; it is carried upon a wooden frame, by means of a sort of fork, placed about ⅜ of its length from the butt (no more of these are now manufactured).

Rampart guns were apparently manufactured in some quantity in both France and England during the first half of the eighteenth century. The French arms were of 0.75 inch caliber with 46-inch barrels, and many of the English had a one-inch bore and 54-inch barrel. Some of the latter are in the Tower armories.

Rifled variants of the rampart gun appeared on the American scene in 1776. Colonel Feilding Lewis wrote to General George Washington on February 4. "I propose making a rifle next week to carry a quarter of a pound ball. If it answers my expectation, a few of them will keep off ships of war from our narrow rivers and will be useful in the beginning of an engagement by land."

Evidently, experiments with the above rifle led to the manufacture of this type of arm at the Rappahannaock Fotge in Virginia. Major General Charles Lee wrote to General Washington on May 10 from Williamsburg, Virginia:

"I am likewise furnishing myself with four ounced rifle-amusettes, which will carry an infernal distance; a two-ounced hit a half sheet of paper 300 yards distance."

In the third quarter of the sixteenth century, a short *arquebus* came in to use, most probably for the first time in France, with both the upper and lower edges of its butt stock curving slightly downward. The curvature of the butt stock was gradually increased in the latter version until it ultimately resembled a hockey stick ending in an ample butt plate. Guns fitted with such stocks were meant to be fired with the butt plate resting against the chest, rather than the shoulder, and only light guns fitted with such stocks could be fired with comfort. These guns were therefore known as poitrinal in French (French poitrine for breast and the Latin pectus/pectoria for chest), subsequently *anglicized as petronel* (Fig. 11.22(a) to Fig. 11.22(c)).

This type of butt was in use upto c. 1600, particularly in France, Germany and the low countries. Initially, the name petronel was supplied only to guns fitted with such crooked butt stocks, but by the second quarter of the seventeenth century it was applied to almost all guns and carbines for mounted use. By this period carbine was also standardized with an overall length of about three feet, length of about two feet and six inches and a caliber of 24 gauge. Another major contribution to develop matchlock firearms and incidentally evolving a separate group of firearms was the rifling of the barrel. Although the word rifle meant to groove in Danish, it is not known definitely when and by whom the process of rifling was invented. One manuscript of Leipzig dating 1498 gives an account of a system of cutting grooves in a barrel as developed by Gasper Kolliner of Vienna. The grooves were straight which indicate that the inventor introduced rifling to facilitate loading and cleaning, rather than giving a bullet a rotational flight to increase the range and stability which is the main aim of modern rifling. Rifling is also ascribed to August Cotter, who worked in Nuremberg from 1500 to 1550. At about this time twist rifling does appear. An Italian

inventory of the year 1476, for example, lists firearms with spirally grooved barrels.

Two rifling consists of spiral grooves inside the barrel to give a spin to the bullet during flight and to correct any irregularities in the flight trajectory.

The earliest surviving examples of a rifle is a hand gun of the Landknecht type in the collection of W.G. Renwick. It has faint traces of rifling at the muzzle end of the barrel. An Eagle of the type portrayed at the period of Maximilian I (1493–1508) is painted on the stock of this rifle.

Danish records indicate that the military use of rifled barrels was introduced first in that country by Christian IV. He lived from 1577 to 1648. A surviving example dated 1611 is now held at the Woolwich Arsenal, England.

11.10 European Matchlock Firearms in Military Roles

Matchlock firearms were mainly useful for the infantry in organized battles. For instance, they were not popular with either cavalrymen or a sportsmen because of the unreliable slowmatch. For this reason, and also because of prejudice, firearms were at first ignored by the upper classes while selecting their personal arms, both for war and sport. Therefore, adaptation of matchlock firearms was not so quick as it should have been.

However, with the introduction of Matchlock muskets, the infantry became the backbone of the fighting forces. Heavily armored and glamorous knights were no more the deciding factor on the battlefield. A historian records that the knight, famed for his chivalry and honor, forgot his attributes when he encountered a hand gunner and summarily hanged him if he had the luck to overpower him.

In England, it was Warwick who revolutionized military tactics by introducing matchlock firearm. Although the Burgundian merceneries at the second battle of St. Albans did little damage with their matchlock

muskets due to heavy rains during the engagement that soaked the priming and match, rendering them practically useless, a beginning was made. And by the time of Bannockburn, the infantry equipped with matchlock muskets became so powerful that equestrian knights discarded their armor and horses until the wheel lock carbine and pistol made it once more possible for them to shoot effectively from horseback. During the tedious process of reloading, the musketeer was hapless and so separate units of armored killers were needed to protect them.

Historians are divided in their appreciations of the effectiveness of matchlock muskets in warfare. For instance, Fourquevau[216] was of the view that "…in a skirmish where in tenne thousand harquebussados are shot, they dieth not so many as are man, for the harquebussados content themselves with the making of noyse, and shoot out all adventure."

Paulus Jovios[217] mentions about the engagement between the Spanish *arquebusmen* and the French at the Battle of Cerignola, in 1503: "Neither the courage of the troops nor the steadfastness of the general won the day; but a little ditch, a parapet of earth and the arquebus."

In the fifteenth century and later, many types of matchlock firearms were combined with other weapons of the contemporaneous period resulting in a number of combined weapons such as stick guns, battle axe, pistol clubs, holy water sprinklers and so on. The last mentioned was a mace, the bulbous head of which contain four or more barrels, fired by a single flash pan connected to all the vents.

The matchlock musket, actually the musket fitted with a tricker lock, was used for military purposes upto the end of the seventeenth century – reign of Charles II (1660–1685), James II (1685–1689) and the early years of William and Mary (1689–1702).

11.11 The Indian Matchlock

Unlike most other oriental countries (Fig. 11.10(a) to Fig. 11.10(j)), the majority of Indian matchlocks were the simple sear lever type. It differed

from its European counterpart in many ways. First, when actuated by pressure on the trigger, the cock, or serpentine, moved forward and carried the match away from the shooter's face. Second, instead of a slotted tumbler it was fitted with a simple tumbler connected to a separate link, both pivoted at the junction by means of a transverse pin through the gunstock. Third, the lower end of the sear lever itself was cut near the butt stock and flattened and shaped to form a blade trigger, or finished as a carved trigger. Fourth, the mainspring exerted pressure downward on the trigger end of the sear lever and kept it pressed out of the recess in the butt stock when it was not pressed. Last, the entire lock mechanism, excepting the extremities of the cock and the trigger, was let into a slot cut into the butt stock. And neither a lock-plate nor trigger guards were fitted. However Indian Matchlocks somewhat resembled the locks of Persia, Turkey, Afghanistan, Bhutan and other neighboring countries.

The flash pan of Indian matchlock guns was invariably made as an integral part of the barrel and a simple pan cover, initially in the form of a detachable clip chained to the butt stock below the pan. Sometime later a pivoted pan cover was fitted that could be operated manually by moving it sideways. Blackmore[218] refers to an earlier souce[219], in which an illustration of an Indian matchlock with an automatically opening pan cover is shown.

A characteristic feature of Indian matchlocks is a small metal pricker for clearing the vent and touch hole, which is chained to a container attached to the butt stock just below the pan. Another gadget not found on European matchlock is a narrow funnel-like tube, also attached along with the pricker, to extinguish the glowing end of the match attached to the cock. This pricker is meant for clearing the tube of ashes collected in it when the match is extinguishing in it. No attempt seen to have been made to this simple lock mechanism of the Indian matchlock up to the modern times. Such apathy on the part of the majority of Indian races is not very unusual as even simpler and cruder implements such as the wooded plough and the bullock

cart of the medieval period are still used in India in more or less the same forms till today.

11.12 The Indian Matchlock Firearms

A little historical background of India of the late medieval period will help us to evaluate the chronology of development trends of Indian firearms in their formative year. It could be recalled that there were three important highways of commerce which were used for trade since ancient times. The first of these was through Afghanistan, Central Asia and terminated at the Caspian Sea. Constantinople on the European side of the Straits of Bhosphorus became the distribution center for the goods brought from India through this route. The second route was through Persia and Syria, and loading to the port of Alexandria on the Mediterranean coast of Egypt. The third route was mostly by sea, and ships carried goods through the Arabian Sea, the Persia Gulf and the Red Sea. Then they were taken by the land to the port of Alexandria. The merchants of Venice and Genova carried those forward to the other European muskets.

The last two routes were virtually closed in the seventh century when the Arabs conquered this region and the trade passed into their hands. The first route was also threatened by the rising power of the Turks a few centuries later. Ultimately Constantinople on May 29, 1453, and all the three trade routes were blocked and made it virtually impossible for the European traders to use these routes to trade with India and other eastern parts of Asia.

In 1497, a Portuguese navigator named Vasco de Gamma sailed along the Atlantic coast of Africa, rounded the Cape of Good Hope and reached Mozambique (South Africa). There Vasco de Gamma hired the services of an Indian Pilot and sailed toward India. On April 23, 1498, he reached Calicut on the western coast of India and was warmly received by the Hindu ruler Zamorin.

By the beginning of the sixteenth century, the Portuguese established their supremacy in the Indian Ocean. Albuquerque consolidated this supremacy by establishing bases and fortresses at strategic points, and also by concluding alliances with the rulers of the strategically important coastal areas.

The Dutch who closely followed the Portuguese along the sea routes were unable to challenge the Portuguese naval power and so sought land territories further ahead, such as Java, Malacca, Colombo and The Spice Island in the seventeenth century. They were followed by the English and the French whose rivalry in the eighteenth century was fully decided in favor of the British naval supremacy. After sufferance's failure to establish the French supremacy in the Indian Ocean, during the struggle which lasted from 1742 to 1784, the British authority in the Indian Ocean was never again questioned until Singapore fell to the Japanese in the Second World War.

It was already mentioned that while northern India had well-established land routes to the east as well as the west, the southern region of the peninsular India depended mainly on the sea routes for trade and commerce. These routes were in use much before the Europeans discovered the sea route via the Cape of Good Hope. By means of these sea routes both the eastern and western coasts of the Indian peninsula had established good trading relations with the neighboring countries from early medieval period.

The Indians were undoubtedly the greater adherents of matchlock firearms. Many western authorities on early firearms assert that the matchlocks of the southeastern regions of Asia, including India, were copied from those of the Portuguese and Dutch marines, who had ventured into the Indian Ocean in search of trade. Perhaps this may be the case in some oriental countries such as Burma, Malaya, Japan and other countries. But when we examine the Indian annals carefully taking both the historical and geographical backgrounds of the fifteenth and sixteenth centuries, this generalization does not seem to be correct in the case of India and China. Careful study of the surviving examples of matchlock firearms of Indian

origin show that there are two distinct trends of development of matchlock guns, one typically north Indian and the other peculiar to the peninsular India.

The north Indian type of matchlock firearms was undoubtedly introduced by the Mughal invaders in India before the advent of the Portuguese or Dutch traders. According to Peterson[220] the matchlock firearms apparently first came to India, Pakistan and Afghanistan overland through Persia. Their general line of construction, stocking styles, the manufacturing processes and decorations bear ample proof for this hypothesis. The matchlock firearms of the southern regions of India show different trends in almost all these respects.

The southern and coastal regions of India had direct contact with the eastern regions of Asia and the countries bordering the coastline of the Arabian Sea up to the Cape of Good Hope during the early medieval period. Thus, only two probabilities are worth considering: First, that the Indians of the southern region have developed their own version of firearms independently or they had obtained the technical know how about firearms either from the Chinese or the Arabs during the course of their trading relations with these countries and then developed their own versions from them.

11.13 Indian Matchlock Guns

Indian names for matchlock guns of the northern and central region of India appear to be mainly derived from the Arabic, Turkish and Persian equivalents. The matchlock gun is known as *bunduk toradar* or *tufang*. The Arabic word *bunduk* originally meant a hazel nut, then a lead bullet and finally a gun. The word *toradar* was probably derived from two words – *tor* for the material with which the slowmatch was made and *dar* for a holder – which literally means a match holder. The match was also known as *fatila*. Imported matchlock guns were normally differentiated from those made indigenously by suffixing the word firangi, such as tufang-i-firangi.

Indian matchlock firearms were classified and named either by their sizes or the way they were mounted, or the manner in which they were propelled, or the specific uses for which they were designed. The *jazail*, or *jazair* was a swivel gun. They were long matchlock guns of different caliber using ball not exceeding a pound in weight and were fired from the back of camels,a wall piece or a swivel gun. It could also be a large musket, wall piece, swivel, a rifle, used with a prong or rest – length about eight feet. It definitely required a support while firing. According to Peterson[221] the *jazail* is an Afghan gun with a slender, curved butt stock. It is distinguished by the Afghan stock (actually from Sind) by its narrow oval butt. Originally, *jazails* were matchlocks, but they were converted to flintlocks. Most were fitted with a U-shaped barrel support.

The *ginjal* was a longer version of the *jazail*, about eight feet or more, and was fitted with a swivel and mounted as a wall piece for defensive roles. They were made in different calibers and iron balls weighing up to a pound in weight could be fired from them. They were also mounted on camel backs and used as mobile light artillery.

The *sak-i-tufang (ginjal)* was also a heavy matchlock gun that was fired from a fixed place, and having a sustantila barrel was too heavy to be used without a rest. Many had an iron prong, about a foot long, fixed on pivot and then placed on a wall, bush or ground, which served as a support. It carried a ball from one to three ounces in weight.

The *ghordahan*, meaning wide mouth, was a matchlock gun fitted with a barrel flared at the muzzle.

The *sher-bachcha* was most probably a blunderbuss, or musketoon. It is believed that it was introduced into India either by Nadir Shah's army in 1738 or by Ahmad Shah Abdali (1738–1761). It was a mountain gun used by the Sikhs. The barrel was shorter than that of the carbine but its mouth was wider and truly trumpet shaped. The Tufangchah was a carbine used by the cavalry.

The *tamanchah* was a pistol and was used in India as early as the seventeenth century. The *currah* was either a caliver or a curriar of Europe.

The *dhamaka* was a large bore gun mounted on a swivel or fitted to the *hawdah* of an elephant or camel. It is made of either bronze or iron and fired charges to produce only loud reports. It was generally used as a signaling gun during military operations.

The *gubrah* was a mortar for launching shells. Lt. William Barr[222] states: "A barmar gun is a light artillery piece according to some is actually any muzzle loading gun." According to Pant[223], Baden Powel states that the *barmar* is a combined matchlock slowmatch and flintlock techniques. It was invented by Mirza Bahrmer of Ranjeet Singh's army and hence its name.

The *hathnal* was a matchlock gun fitted with a swivel and mounted on the back of an elephant; the *aspi* was a similar gun mounted on horseback; the *gowai* was a matchlock gun drawn by a bull; the *shutri* was a piece mounted on camel back and *zamburak* was fitted to a tripod. The effectiveness of firearms mounted on animals in offensive operations in battle is very questionable. The musketeer trying to load, prime and discharge his piece and at the same time keeping his mount under control while it panicked at every shot fired, must be quire exasperating. Perhaps a volley fired may be effective in dispersing the advancing ranks of an enemy force, particularly of the cavalry, by causing panic to their mounts.

According to Pant[224] Maharaja Ranjeet Singh reorganized his departments of artillery into separate wings. Topkhana Jinsi was a mixed artillery regiment, comprising of *aspi* (horse-drawn), *gowai* (bullock-drawn), *pili* (elephant-drawn) and *shutri* (camel-drawn). This classification and nomenclature appear to be more appropriate for field guns such as cannon.

Among the Mughal emperors, Akbar (1556–1605) was the greatest admirer of matchlock guns. The Imperial Arsenal during his reign contained many matchlock firearm guns, both indigenous and imported. He directly supervised the manufacture of guns and employed many able gunsmiths to

carry out the specialized jobs involved in the manufacture of guns. The guns made in his time were classified into three categories; *sada*, those without any decoration or ornamention; *rangeen*, those decorated colorfully by varnishing, painting, enameling or jewelling; and *koftkar*, those inlaid with precious metals, such as gold and silver. Normally, each piece was stamped with the name of its maker, date and place of manufacture, weight of the raw and finished metals used and so on. The imported piece in Akbar's arsenal was either purchased or presented to him. F. Bernier[225] recorded many of his observations (to section of artillery). Akbar's matchlock guns were mainly of two sizes, 66″ and 44″ long. Heavy matchlocks were mounted on tripods and were called *sack-i-stufang*.

Dara Shikoh, the eldest son Shah Jahan, held the Viceroyalty of Allahabad, Multan and the Punjab. Although Aurangazeb was his younger brother he aspired to his father's throne by eliminating Dara. The most important war of succession between the two was fought at Samrugarh, near Agra, on May 29, 1658. The accounts of the decisive battle that ensued are well chronicled and one of the contemporary historians describes: "After the victory at Dharmat, Aurangazeb crossed the Chambal river and met the Imperial Army, of a strength of about 50,000 combatants, under direct command of Dara himself. However, excepting the Rajput contingents and Dara's own troops the rest were unreliable. Dara placed a great number of camels, on the foreparts of their bodies small piece of the bigness of a small musket, a man sitting on the hind parts of the camel being able to charge and discharge without alighting. From this description it is evident that camel mounted matchlockmen were of no avail as Aurangazeb's victory was complete and Dara's defeat most disastrous. Nevertheless, camels were used in the desert regions of India for warfare until recent times. Perhaps no other animal could withstand the rigors of the desert better than the camel. Some Grenadier battalions of the Indian Army used camels until recent times."

In the sixteenth century, the European matchlock was modified into a number of superior versions. Also new and better systems of ignition such as the wheel lock, and snaphance started replacing the matchlock. Although in India the simple sear lever type of matchlock was in use up to the nineteenth century. Even the royalty and nobility of India were not aware of these developments and until the reign of Emperor Jahangir (1605–1627) no mention is made in the contemporaneous Indian annals.

Aravamuthan[226] records that Petro Paula, who worked as a Carmalite friar in India, wrote to one Manucci in 1680 that he knew about a matchlock that could fire five to six times it was once loaded, and whenever he chose to do so.

It would be of interest to study the reasons for the apparent reluctance on the part of the Indian soldier and sportsman to change over to the new and better system of ignitions, or improved versions of locks, which had superseded the sear matchlock centuries earlier, in other parts of the world. There were many reasons for this that are examined in the following pages.

It could be recalled that in England, the royalty and the classes looked on early guns as implements of war and sport. The British with their characteristic obstinacy, insularity and superiority complex, not only ignored all contributions originating from the continent but also clung to their longbow as the principal weapon for fighting forces for well over a century after the introduction of the hand gun on the continent. In the field of sport also they preferred to use horses, dogs, falcons, bows and nets, instead of guns. Perhaps the earliest exceptions were the peasants of England who took to matchlock guns for pot-hunting and poaching.

Firearms in general and matchlock guns in particular were used only to a limited extent in Indian warfare up to the beginning of Mughal Period. During the Mughal Period, cannons were used to a larger extent but portable firearms of the matchlock variety were used only to a limited extent. These guns were neither popular with the cavalry nor for close

combat. An average Indian soldier had more confidence in his sword and shield than in the long, heavy, clumsy and temperamental matchlock gun. As late as the Third Battle of Panipat (1761) the Maratha cavalry fought with the lance and sword while their opponent preferred the musket and cannon. Each soldier had a musket by his side but he had neither love for it nor the expertise to use it effectively. He preferred the lance and spear for close quarter battles to the clumsy bow and arrow, or the heavy and long matchlock gun. Another contemporary historian, Bernier[227], observed about the artillery of Aurangazeb and that of the Mughal Army: "Musketeers squat on the ground and rest their muskets on a wooden fork which hangs to them – afraid of an evil spirit causing the bursting of their muskets, which may burn their eyes and long beards." He also observed: "All their cavalry they draw bows and arrow with marvelous swiftness, one man being able to draw six of them before a matchlock could be fired twice." This gives us a fair indication not only about the effectiveness of the matchlock musket in action but also the capabilities of Indian musketeers' matchlockmen in its use. The matchlock gun was, therefore, normally used in Indian warfare as a defensive weapon or as a piece of light mobile artillery.

Gode[228] mentions that *Kamachandrapant Amatya* (A.D. 1650–1733) who had a close knowledge of the Maratha administration under the Maratha kings, *Sri Shivaji Maharaja* and his sons *Sambhaji* and *Rajaram*, composed his celebrated *Ajnapatra* dealing with Maratha Polity. It is dated November 21, 1716 and gives the nomenclature of terminology used for firearms and connected items. They are *bundooki (musketeer), ramchangya (a king of gun), philanak or philnal (a gun mounted on an elephant), sutarnal (a gun mountd on a camel), gadyawaril bhandi (a gun on wheeled carriages), karol (mounted musketeer), hoke, hooka or hukka (vessels filled with gunpowder or boms, or baan or sarung), daaru goli (power and ball), baan (rocket), bhandi (cannon), jamboore (small bundooks or swivel guns), charkya, gaj (ramrod), palakha, phaal, jamagya (slowmatch)*, etc. He summarizes with the word: "The foregoing notes amply show the use of firearms by the Marathas in the

seventeenth century. I do not, however, notice in them references to the manufacture of cannons and muskets as I found in the section on artillery in the *Ain-i-Akbari*."

The wheel lock, snaphance and flintlock were very complicated locks when compared to the simple matchlock mechanism and very few Indian locksmiths of the period could manufacture them at reasonable cost. Cost of imported guns fitted with locks other than matchlocks were exhorbitant by the Indian standards. Hence, only the royalty and the wealthy could afford to purchases them. Emperor Jahangir wrote in his memories: "I had in my possession a certain fowling piece, for which I understand Mirza Rustam (Raja Jai Singh of Amber) had offered the former owner a sum of rupees 12,000 and twelve horses without any success." I indeed paid a princely sum to pay for a single gun in those days. One could just imagine the astronomical cost of equipping the typically large Indian armies with such expensive firearms.

In addition to the prohibitive cost, these new types of locks contained a large number of small parts and only expert gun fitters maintain and repair. It was extremely difficult to keep them in working condition, particularly in operations, as the users did not have the technical aptitude attend to their maintenance and timely repairs. Even the simple matchlock gun in the hands of an Indian soldier was invariably neglected and rendered unserviceable with minor defects.

One of the main reasons for improving the introduction of new types of locks was to improve the efficiency of guns so that they could also be used effectively for game shooting. In India, an average sportsman had hardly any scope for shooting game birds or animals in the Indian states throughout the Hindu and Mughal Periods. The entire wildlife in the states was treated as the personal possessions of concerned rulers. They imposed heavy punishments, such as public flogging, imprisonment and even death for poaching to kill animals or birds without their specific permission. The privilege to hunt and shoot wildlife was only that of the royalty and their

personal guests. A commoner was not permitted to shoot, even if he had the means. Therefore, the gun was not of an attraction to either an average Indian sportsman or to a poacher. Perhaps, the cheap and silent bow or spear suited them better than the noisy gun.

Almost all paintings, illustrations of the fifteenth century depicting royal hunting scenes show Indian sportsmen using horses, dogs, sword, bows, lances, spears, hawks and so on, with the gun conspicuous by its absence. It could, therefore, be safely presumed that the sportsmen of this period did not choose the gun. Perhaps, the brave hunters of those days considered killing game deprived them of the pleasure of pursuit and the thrill of killing game at close quarters. It is also a fact that game animals and birds shot with guns died almost instantaneously and rendered it unfit for human consumption as per the dictates of the Koran, which specified that animals killed for their meat should be slaughtered by slitting their throats before they died. It could be recalled that the British sportsmen also did not adopt the gun for sport until such time it was improved to kill flying birds and running game, in the early part of the seventeenth century.

It could be seen from the surviving examples of firearms fitted with advanced types of matchlocks and new types of locks, that they were invariably imported from England or the Continent. Quite a few of them were also manufactured in India but the locks fitted were imported ones.

In c. 1600, Queen Elizabeth granted to the Board of English traders, under the title "the Governor and Company of Merchants of London Trading into theIndies," the monopoly of English commerce, from Cape of Good Hope tothe Straits of Magellan, for fifteen years. This company is generally known as theEast India Company. William Howkins, a representative of this company, met Jahangir with a letter from James I, the king of England, and he was allowed to remain at the Mughal court from 1601 to 1611. An imperial farman was granted to Hawkins in 1613 authorizing him to establish a factory at Surat. After the Portuguese lost their importance in India and the other competitors the Dutch, decided to build their empire in

the Spice Islands, the only rivals who left for England in India were the French.

Emperor Aurangazeb attacked Sadulla Khan of Khandhar for the second time in 1652 but the Indian gunners could make no impression on the fort walls. During the first expedition (1649) also lack of large cannons made it impossible to make any impression on the fort. Mughal inferiority in firearms was mainly responsible for this humiliating failure to reconquer Kandhar.

The war of Austrian Succession, which broke out in Europe (1740), extended to India by about 1746. The French fleet under Donnals attacked Madras and demanded its surrender. Nawab anwar-ud-din of Arcot resented the seizerand sent an army to attack the French. The French defeated the Nawab's army and forced it to retreat up to St. Thomas' Mount. A French commander Paradise was sent after the retreating forces. A contemporary historian writes about this engagement: "It was now more than a century since any European nation has gained a decisive advantage in war against the officers of the Great Mughals. The experience of earlier unsuccessful enterprises and the scantiness of military abilities which prevailed in all the colonies from a long disuse of arms had… That the Moors were a brave and formidable enemy, when the French broke claim of this timorous opinion by defeating the whole army with a single battalion cavalry, fighting according to established Indian practices was useless against well directed field artillery, and against the infantry that could keep their ranks and reserve the fire."

Armed confrontation between the English and the French at the First Carnatic War (1744–1748). Perhaps, it was in this war contemporary firearms such as flintlocks and percussion-lock muskets were used on the Indian battlefield for the first time, as they were the standard personal weapons of the English and the French fighting forces.

The Mughal rulers of India must have had the first taste of the new types of firearms when they started fighting the Portuguese and the English from 1756 onward. Till then they were either blissfully ignorant about the new types of locks or were quite content with their cheap matchlock guns. As already mentioned, the cost of equipping the massive Indian armies with firearms fitted with expensive locks was also a major factor which retarded the introduction of much improved versions of firearms in to the Indian armies. Consequence of this lapse naturally led them to utter defeat when they ultimately decided to fight the British forces who were already equipped with more advanced types of firearms fitted with new and better types of firing mechanism.

Colonel Henroe, the victor of the Battle of Buxar, speaking of the period 1763–1772, held that the Indian princes got their artillery piece from Europe (England, Holland and France). Though they came to India they (British) did not sell those cannon and small arms. Most of the gunpowder they made by themselves.

The locks introduced after the matchlock undoubtedly originated in Europe. They were intricate, needed specialist locksmiths to make, very costly to manufacture and difficult to maintain and repair, particularly under field conditions. Apart from these disadvantages, all the spare parts needed to repair them had to be imported and when they were not available the weapons became unserviceable. During the last phases of the Maratha fighting, a historian records: "…their arms for most part English and out of twenty-two would be found without locks, six without cocks and, perhaps, note a flint among the remaining twelve": No wonder the sword, the spear and the simple matchlock were continued to be used in India, both for war and sport, up to about the end of the eighteenth century.

Important armories where firearms were manufactured in India were at Lahore, Amritsar, Koyli-Lorahan, Kashmir, Wazirabad, Delhi, Agra and Hyderabad.

Some Indian nomenclature of Firearms: percussion-cap gun – bundook masalada; field piece – ramjanki, qasarah; organ – 36 barreled gun; singra – powder-flask; champ-lock; pirangi – cannon.

Gode said[229]: "The word pirangi appears in a poem Kanthiravana – Rasaraja-Vijayan composed in c. 1648. They were carried on carts together with thousands of bags of gunpowder, taken with the army in the expedition of Ranadulla Khan against the king of Karnataka and his feudatories."

The author of the above poem is Govinda Vaidya. He was a resident of Srirangapattanam and a court poet of the Mysore Kings. He wrote this poem at the insistence of Nanja Rajendra (1638–1659), the general of Kanthi-ravsn in the year 1648.

11.14 The Wheel Lock (*Chakmaki*)

Matchlock had many disadvantage and the worst was to rely entirely on the long glowing match (as much as 9" long) slowmatch as an ignition (Fig. 11.11(a) to Fig. 11.11(e)). Susceptible rain in the ice of the enemy scouts, the slightest drizzle extinguished its smoldering tip and the match became useless until it was dried thoroughly. The close proximity of the smoldering tip of the match to the pan was always a hazard, particularly so while the piece was reloaded. The glowing tip of the match betrayed the location and movements of the shooter at night.

There were, however, some instances when the glow of the smoldering match was used advantageously by military commanders on the battlefield. An anecdote narrated by one John Smith, of tobacco fame and at one time a mercenary serving in Europe, is a typical example. Smith accounts about one of his engagements against a stronger force of Turks who were about to mount a night attack. He rigged up long ropes with pieces of slowmatch attached at regular intervals, and ordered a few soldiers to light the pieces and march toward the enemy ranks with the ropes held between them. As the captain expected, the Turks fled the field mistaking the strings of

glowing matches for a stronger force of matchlockmen advancing toward them.

Nevertheless, matchlock firearms were clumsy weapons on the field and very unsuitable for mounted use and mobile operations. A better system of ignition was, therefore, sought, which need not rely on the slowmatch. In the late stone and Bronze Ages (50000 B.C. to 10000 B.C.), humans produced fire from sparks struck with a nodule of iron pyrites and a piece of flint or quartz. Later, when he produced steel, he was able to strike quite easily flint and steel to strike sparks and start a fire.

From the fifteenth century every matchlocks carried a piece of steel, a few pieces of flint and a box of dry tinder to set alight the slowmatch. As it was a tedious operational process to ignite the match every time it got extinguished, which was very frequent, he kept both ends of the match smoldering continuously, while out shooting. It is really surprising that it did not occur to him earlier to apply the sparks struck by the pyrites and flint directly to the priming to fire the piece. However, the idea did occur to an unknown inventor, at an equally uncertain date, and the wheel lock emerged.

Arms historians are not yet definite just when, where and by whom, the wheel lock system of ignition was invented; although the credit for inventing it in c. 1517 traditionally goes to a gunmaker Johann Kiefuss. Some historians believe that he was from Nuremberg, (Bavaria) Germany, whereas others place him in Vienna.

Research scholars have now brought to light certain evidence that the first wheel lock may have been made further south, possibly Italy or Hungary. Their sources are three manuscripts of the early sixteenth century which throw new light on the origin of the wheel lock system of ignition. The earliest of the three is Codex Atlanticus, in Abrosiana, Milan, which is a collection of military sketches and drawing by Leonardo da Vinci, who lived until 1519. Leonardo was employed by Duke Lodovico il Moro of Milan,

from 1483 to 1499, and it is generally believed that these drawings were prepared by Leonardo for the Duke in c. 1508. Two of these sketches are ignition system, actual or projected, using the principle of striking sparks by friction. One of these at Folio 56 b closely resemble the true wheel lock system which followed later.

The second manuscript to indicate the probable origin of the wheel lock is a volume of drawing by Martin Loffelholz, of Nuremberg, Germany, datedc. 1505. It was formerly held in the Staat Bibliothek, Berlin, but now untraceable. Last, a supply order from Germany, dated 1507, by the *Steward of dinal Ippolite d'Este I,* for a gun of the type that is kindled by a stone. These manuscripts prove beyond reasonable doubt that the wheel lock system of ignition, either actual or projected, was conceived much before 1517.

Before the true wheel lock was introduced some intermediate forms of ignition systems were made which utilized sparks struck with pyrites and steel to ignite the priming. One much system, probably made in at the end of the fifteenth century known as the rasp-lock. A long oblong metal box was placed at the breech end of the barrel. It contained a roughened steel bar resembling a rasp of rectangular section with a handle of its end. A cock with a pair of adjustable jaws holding a nodule of iron pyrites was positioned so that the pyrites rested against the toughened surface of the bar, close to the pan containing the priming. When the handle was jerked hard by hand, the friction between the pyrites and the bar struck sparks which fell into the pan and fired the piece. Rasp-lock was in use, along with wheel locks, particularly in cannons of the sixteenth century. A surviving example of a pistol in the Historiches Museum, Dresden, the so-called Monchbuchse (Monk's gun), after the legendary monk Bertholdus Schwatz, is made of iron and 28 cm overall length and fitted with a 25 cm long barrel. It is fitted with a metal ring projecting below the barrel to afford a better purchase for the hand holding the barrel. A belt hook is also fitted at the breech end of the barrel.

Another form of lock utilizing the sparks struck by friction – the segment lock – was probably first made in Italy. In this lock, a pivoted steel segment (striker with a grooved or serrated edge is fitted with a handle). When the segment is pulled fully back, one leaf of the mainspring locked the rear of the segment and held it from returning back. The other leaf of the mainspring rested against a shaped metal plate attached to the cock spindle. The cock held a nodal of mineral pyrites pressed against the rough edge of the segment. When the segment was released by pressing a trigger, the segment moved by the pressure exerted by the mainspring acting on it and the friction between the rough edge of the segment and the pyrites generated sparks to ignite the priming. The segment lock was also in use along with the true wheel lock.

Probably, the earliest surviving wheel lock firearm, rather a combined weapon – crossbow and wheel lock pistol – made for the Archduke Ferdinand, of Austria, is held in the Bayerisches National Museum, Munich. From the monogram and coat of arms on this weapon, it was probably made in Nuremberg between 1521 and 1526. Three such combined crossbow and pistol weapons, made in Italy in the school decade of the sixteenth century, are also exhibited in the Palazzo Ducale, Vienna. The earliest dated wheel lock carbine (small saddle *arquebus*) is in the Royal Armoury, Madrid, which was probably made in Augsburg in 1530. It bears the two sickle marks of Bertholme Marquart, the Elder of Augsburg, South Germany, and was probably purchased by Emperor Charles V when he visited Augsburg in the year 1530.

The above examples have fairly well-developed wheel lock and it is quite likely that some early types of wheel lock must have been made at earlier dates. Such types, though undated are extant, and so it seems reasonable to believe that the wheel lock must have been introduced at a date close to the end of the fifteenth century. Peterson[230] mentions that several primitive wheel locks which could be dated before the first decade of the sixteenth century or earlier, several of these primitive locks are, or were, held in the

National Museum at Budapest (Inv. No. 17/1906 A-E and one unnumbered specimen), where he saw them in a heap of metallic rubbish and called to the attention of the authorities. One of these eventually traded to the arms collection of the Austrian National Arts Museum at Vienna. Similar locks are to be found on three combined pistols and crossbows (Inv. Nos. Q 1 to 3) in Doge's Palace Museum in Vienno, two hand-axe and pistol combination weapons in the same palace (Inv. Nos. Q7–8), and a combined hammer and pistol in the Ferdinandeum Museum at Innsbruck (Inv. No. 1035), as well as several others.

A self-spanning wheel lock *arquebus* dated 1546 was probably made near Montserrat in Catalonia, it's south German style, however, makes it likely that it is the product of an Itisarant German gunsmith rather than that of a Spaniard. However, according to Peterson[231], from the contemporary inventories, the earliest known Spanish maker of wheel locks is Cristobal Frisleva of Ricla, active in the third quarter of the sixteenth century. After Madrid became the capital of Spain in 1561 it became the main center of Spanish firearms manufacture. Wheel locks made there after the third quarter of the sixteenth century show that the Spanish guns had assumed a characteristic of its own while maintaining distinctly the German flavor.

Spanish wheel lock guns were exceedingly simple, even those made by such renowned gunmakers as the Marquarts of Juan Salado, and were almost devoid of ornamentation. *Arquebuses* were generally small, seldom exceeding six palms in length.

German watchmakers and clockmakers were the best in Europe and so they were able to make the complex wheel locks. It is also quite probable that the majority of wheel locks found on European firearms were imported from Germany. Wheel locks were also made in Italy and France. The French wheel locks had their mainsprings fitted into the stock instead of attaching it to the lock-plate as the German types.

One of the main difficulties to establish the exact place of manufacture of the surviving examples of early wheel lock firearms is the absence of the gunmaker's signatures on them. It is also a fact that there was considerable trading in both guns and gunmakers, particularly from Germany. Some German gunmakers migrated to Italy, Spain, Sweden and France, where they found patronage of the royalty, aristocracy and wealthy. For instance, some gunmakers migrated to Italy and were used by the Duke of Montua, and another family of gunmakers, the Marquarts, migrated to Madrid and became the Royal Gunmakers of Spain in 1575.

With characteristic German patriotism these German emigrants continued to stamp firearms they made with German characters. It is also a fact that some firearms made by them bear some characteristic or other of original German versions. One such feature is the sickle-shaped cock spring. It occurs first in the combined crossbow and wheel lock already mentioned. As many wheel locks are dated, it is possible to ascertain the approximate period's during which certain characteristics were incorporated on wheel lock mechanism. For instance, the cock spring fitted during c. 1520–1535 was unmistakably of the sickle-shaped type. But from c. 1535 to about 1545, the blade of the sickle almost encircled the wheel and its handle protruded out at right angles; and during c. 1545 to 1560, the handle of the sickle curved upward where it is fastened to a circular blade.

11.15 Working Principles of Wheel Lock

Working principle of practically all wheel locks is somewhat similar to that of a modern cigarette lighter. It normally consisted of a solid steel wheel, upto 2 cm thick, with its grooved edge traversed by numerous cross cuts, mounted fitted rigidly to a spindle or arbor mounted at right angles to the lock-plate. The wheel spindle was positioned in such a way that the upper edge of the wheel protruded slightly out of a slot cut in the bottom plate of the pan. One end of the spindle protruded out of the lock-plate through a hole and suitably shaped, usually squared, so that it can be turned by a special key, or spanner, fitted to it. On the enclosed side of the lock-plate a

short strong metal chain of three links is attached with the third link attached to a specially shaped cam, or toggle, also mounted on the wheel spindle. The other end of the chain was attached to a hook at the end of a leaf of a powerful V-spring, generally known as the mainspring. When the key was turned, usually about three-quarters of a turn in the clockwise direction, the chain wrapped itself around the cam and compressed the mainspring.

A short small spring-activated lever, the sear, with a small beveled point (lug) at its end was also mounted on the enclosed side of the lock-plate. A weak spring – the sear spring – kept the beveled point pressed out of an opening in the lock-plate and engaged on the inside surface of the wheel. When the key is turned, the wheel rotated until the chain is wound around the wheel spindle and the cam is raised against the pull of the mainspring. When the wheel was fully spanned, a depression on the surface of the wheel came in front of the lug of the sera lever and it entered the depression due to the pressure exerted by the sear spring and stopped the wheel from turning any further, and the lock was now spanned with the wheel held fast by the lug.

The lock-plate of the wheel lock was specially shaped so that the pan lies along its upper edge. An angular arm, the dogshead or cock, is set in front of the pan and pivoted to the lock-plate in front of the wheel. A nodule of iron pyrites or Marcarite, the spark-producing mineral, with a padding of lead or leather is fixed firmly between the adjustable jaws of the cock with the help of a thumb screw, or a nut-beaded screw. Another V-spring, the cock spring, weaker than the mainspring acted on a projection of the base of the shaft beyond its pivot, to force the pyrites into contact with pan cover, or the revolving wheel. In some wheel lock, the cock is kept away from the pan and along the barrel so that the gun is safe after leading, priming and spanning the piece.

The pan is fixed in the side of the barrel, with a touch hole leading into the chamber of the gun. In most early versions of wheel locks, the pan cover was

manually operated, but soon automatically opening pan covers were introduced with a spur fitted to the pan cover engaged by a lug on the rotating wheel spindle, or by the friction caused by the rotating wheel itself. In the early locks, the wheel, mainspring and the chain were all fitted externally on the lock-plate and it was only later that they were shifted to the inside and encased within the stock and covered by the lock-plate.

The pan cover which was kept closed to keep the priming powder within from falling out or becoming damp due to wind or weather. It was normally spring-loaded and could only be kept open by closing a manually operated catch. In many sixteenth century examples, the pan cover released by pressing a button. In some improved versions of the wheel lock the pan crew moved out of the way by the friction of rim of the rotating wheel against the under surface of the pan cover. In some advanced types of wheel locks, the pan cover was switched by a linkage can attached and mounted on the wheel spindle and opened the cover when the cock was lowered.

Wheel lock firearms were loaded, with powder and ball, through the muzzle; the pan primed with powder and the cover shut. The dogshead was now swung forward and down until the pyrites rested on the pan cover, and then the lock was spanned. Pulling the trigger, the beveled point of the rotating sear which is engaged within the recess on the face of the wheel, withdrew inward and released the wheel to rotate freely. The main spring immediately decompressed and the arm connected to the chain unwinding it from the cam around which it was wrapped up and so giving a rapid spin to the wheel. As the wheel started to rotate an eccentric cam mounted on the wheel spindle moved and opened the pan causing the cock to dip into the pan and press the pyrites against the rim of the rotating wheel. The resulting friction between the roughened rim of the wheel and the pyrites struck sparks within the pan and ignited the priming powder to fire the main charge. Iron pyrites were than preferred to flint mainly because the former produced a good shower of sparks and caused less wear and tear on the rim of the wheel.

11.16 Improved Wheel Lock Mechanisms

Numerous improvisations devised to the functional efficiency, safety of wheel locks and accuracy of wheel lock firearms. The ingenuity and skill displayed by wheel lock firearms of the period was indeed commendable. The trigger pull of a wheel lock was considerable due to the strong mainspring it contained which caused the weapon to fire high or upset the aim in other ways as the initial aim was disturbed when the trigger was pulled hard. To eliminate this drawback one more trigger was incorporated in the lock – the so-called set-trigger – more or less similar to the modern hair trigger. When the main trigger was pulled, it took up the major part of the effort to operate the lock parts and left the lock in such a way that only a light pressure on the set-trigger triggered off the actual rotation of the wheel. Now the firearms could be aimed after pressing main trigger and the piece could be fired by a very gentle pressure on the set-trigger which did not upset the aim taken earlier.

As described earlier, in most of the early wheel locks, the wheel was held in the spanned condition by a spring-activated nose of a sear which engaged a recess or hole in the wheel, although in some locks a cam mounted on the wheel spindle was held when the lock was fully spanned. These systems suffered with the snag that premature discharges resulted due to accidental disengagement when the wear and tear of the components beyond certain limits. One solution to this problem was the introduction of the double sear, one engaging the wheel and the other the tail of the first, preventing the nose from disengagement. The trigger engaged the tail of this second, or supporting, sear, and at the moment of firing, pulled it out of contact with the primary sear. The latter, having a rounded nose engaging a tapered depression, was under constant pressure to slip out of engagement and, with the supporting sear removed, it was now free to do so.

Wheel lock firearms needed efficient safety devices to prevent accidental firing as they were invariably carried after loading, priming and spanning, for instant use. Gunmakers, therefore, gave special attention to devise many

types of safety mechanism, in the so-called trigger, hammer, sear, manual and automatic safeties. In fact, practically almost every type of safety device now in use was conceived by the maker of wheel lock firearms. Of course, in elementary forms, at one time or other. With an effective safety mechanism installed the shooter was able to concentrate more on the target and could also align the gun more effectively.

Introduction of the supporting sear, mentioned earlier made it possible for locksmiths to add another manual safety which could be checked for engagement or otherwise. It consisted of pivoted hook with a knob fitted on the outside of the lock-plate and to the rear of the wheel, which could be hooked to a projection, protruding through a hole in the lock-plate of the supporting sear, and locked so that the pressure on the trigger did not disengage the wheel. To fire the piece, the hook had to be moved forward, against the pressure of its spring. So the supporting sear is freed and the trigger could be pulled. From the surviving examples, it is apparent that this additional safety was gradually discarded at the end of the sixteenth century.

In many early wheel locks, the wheel housing consisted of a plate over the face of the wheel, and a separate cover to shield the edge of the wheel and extended to form the spring engaging the tail of the doghead. The early doghead springs, then were an extension of the wheel housing the ring. After the middle of the sixteenth century, however, they were usually separate, generally on the outside, but occasionally on the inside of the lock-plate, in which case they engaged a cam on the rotatable doghead arbor.

The wheel housing itself was subjected to many improvisations. The earlier two-piece unit was now made in one, and the dome-shaped housing was flattened. The Italian-made wheel locks had only a bridle with a bearing for the wheel arbor and a small clip projecting below the wheel and then turning upward to retain the edge. In later wheel locks, the lock-plate itself was suitably recessed on the inside to accommodate the wheel. The contour of this recess was followed on the exterior of the lock-plate in the form of a

bulge. However, by the later part of the seventeenth century the lock-plate was flat, externally.

The other improvisations were of minor nature, such as a rearward projection of the pan to act as a partial shield to protect the shooter's face from sparks from the burning priming in the pan; a long tail to the doghead to give purchase for moving it forward or backward and a tiny plate fitted to the doghead, covering the outside of its jaws to prevent chips of pyrites flying into the face of the shooter.

In some wheel locks, gears were used either to step up the revolutions of the effort required to span the lock with a key. In a few examples, coil springs were used instead of V springs.

The key or spanner was required to rotate the wheel to compress the mainspring and prepare the mechanism for firing. It was normally a bar with a squared hole cut into the end which would fit over a squared end of the wheel arbor. Keys were normally simple tools, but some examples were made with elaborately pierced or chiseled decoration. Some were so designed that they could be used as screwdrivers or powder measure. Normally, wheel lock keys were kept detached from the lock, either in a small shuttered compartment in the butt, opposite the cheek rest, or carried by the shooter in his pocket. It could, therefore be easily lost. Rendering the piece temporarily unserviceable. To overcome this drawback, self-spanning wheel lock mechanisms were developed. In one such self-spanning mechanism, the doghead, and wheel and mainspring were linked in such a way that when the doghead is pulled fully away from the pan and then restored on the down position, the wheel was automatically spanned. Another type of wheel lock was spanned when the trigger guard was pushed down by a system of rack and pinion or by the use of a chain.

Because of the large number of working parts and springs it carried, the wheel lock was prone to develop stoppages, quite often when least desired or expected. To overcome this, numerous innovations were introduced. Some

consisted of dual ignition system that is a combination of wheel lock and matchlock mechanism. The first pressure on the trigger operated the wheel lock and if it failed to work the pressure was sustained which brought the matchlock into operations, many wheel lock examples are fitted to crossbows, maces, halberds, swords, axes and so on, perhaps for the same reason.

Breakage of the mainspring and fracture of the pyrites often rendered a wheel lock unserviceable. To overcome this, some wheel locks were fitted with an additional doghead which could also fire the piece. Some dogheads were fitted with two pairs of jaws holding two separate nodules of pyrites. When one nodule became unserviceable, a swivel nut holding the jaws was reset to bring the other pair of jaws, with a serviceable nodule of pyrites, into the firing position. In some advanced type of wheel locks the nodule of fragile pyrites was replaced by the more hardy and durable flint.

The priming powder produced dense clouds of smoke and bright flames while burning. The smoke obliterated the target and the flames betrayed the shot which followed. To minimize these, a tubular steel chimney, the stack – was introduced. It was fitted just above the pan to carry away the smoke and to partially shield the flash.

Well-designed front and rear iron sights were fitted to wheel lock firearms to improve accuracy. Tubular rear sights were also fitted, particularly to target shooting firearms so that the fumes and flames emanating from the burning priming did not obliterate the target from the shooter's view.

Rifling of the gun barrel was another important development. Originally, barrels were grooved to facilitate quick loading and cleaning. But gunmakers soon realized that the spin imported to the bullet by providing spiral grooves inside the bore improved accuracy of the firearm. Although rifling was in its preliminary stages of development when wheel locks were introduced, barrel makers tried out various combinations of numbers, depths, shapes and degrees of twist, of the grooves cut in the barrels. The

recently revived microgrooving was also attempted for wheel lock rifled barrel. Various types, method of rifling, such as trefoil, quatrefoil, square and heart, are also found on barrels of surviving examples of wheel lock firearms. However, rifling was not widely adopted chiefly because of the expense and the difficulty in loading quickly the ball, which had to be of very tight fit, when barrels are rifled.

In the seventeenth century, some barrels of wheel lock guns were fitted with detachable sleeves, or liners, inside, so that the calibers of the barrel could be increased for big game shooting by removing the liner.

To protect the butt from accidental damage when it was banged on the ground, or any hard surface, a small, metal ball was fitted at the very tip. German shooters of the period normally mounted their guns with the butt to the cheek, an so the side of the butt close to the shooter's cheek was gently curved, or fitted with a cheek rest, to enable him to take effective aim. Recoil was reduced to a considerable extent by fitting very heavy barrels. Trigger guards were large and arched to accommodate the three fingers of the shooter's grip-hand and to provide good purchase so that the heavy trigger pull required could be given without upsetting the aim already taken by the shooter. A recess was often provided on the butt, on the opposite side of the butt to the cheek rest, with the sliding bone or ivory shutter. This compartment held greased patches to rap the bullets before ramming them down the barrel, and other important accessories such as pyrites, a spanner and so on.

11.17 The Tschunkes

For nearly two hundred years the true wheel lock was sturdy and reliable in the hands of both soldier and civilian sportsman (Fig. 11.12(a) toFig. 11.12(h)). Among the sporting firearms made in Germany or any country, one type of Bohemian wheel lock sporting rifle is of interest. Although they were introduced by the end of the sixteenth century, best examples are of the seventeenth century, by which period they appear to have become popular.

A number of surviving examples of these rifles are extant. They are generally known as tschunkes, the name probably derived from the town of Teschen, in southern Silssia, east Germany, originally on the northern border of Bohemia, western Poland, where these rifles were made.

Tschunkes were small wheel lock hunting rifles slender, light and of small caliber normally about 95 cm long and 7 mm in bore diameter. The mainspring, doghead with its spring, and the chain were all mounted externally on the lock-plate, so that these rifles could be fitted with light stocks. The curiously bent stock, with a prominent cheek rest, was made of hard wood, usually good quality walnut and was profusely decorated and inlaid with bone, mother-of-pearl and horn, depicting floral, animal and bird motifs. The rear portion of the mainspring and the mobbing portions of the base of the doghead and its spring were normally covered with two small brass plates to prevent injuries to a shooter's hands while shooting. Almost all the major components of the tschunkes could be examined, cleaned and maintained with ease as they were located externally. It was also quite easy for an armorer to locate and replace unserviceable lock components. The lock-plate, doghead and the brass plates were all engraved with simple floral motifs. The small bored rifled barrel and the bent stock enabled it to be accurately fired, so that the small bullets could be placed on small game precisely. It is believed that, without having to make trajectory calculations, a marksman could hit a hare at 100 meters. It was used throughout the southern German provinces upto the end of the first quarter of the seventeenth century for hunting birds and small game. Birds were normally flushed out of the scrub jungles, along the forest margins, by beaters while teams of sportsman armed with tschunkes shot them on the wing.

11.18 Popularity of Wheel Lock Firearms

As mentioned earlier wheel locks were considerably more expensive than matchlocks and this meant that their usage was restricted to the royalty, nobility and wealthy, who could afford them. These customers demanded higher quality workmenship, ornate decoration and handsome appearance,

worthy of their status. The matchlock was the work of two craftsmen – the barrel maker and locksmith, and the other of stocker. With the introduction of the wheel lock, most firearms were the result of at least half a dozen craftsmen, each an expert, in his craft. The barrel maker and locksmith made the barrel and lock, respectively; the stockmen fashioned the body from walnut, or more exotic woods. The other artisans, such as inlayers, engravers, chiselers, wood carvers and polishers and so on were responsible for decorating the complete weapon.

Even the simplest version of wheel lock was very intricate compared to the most advanced type matchlock. The wheel lock was every locksmith's delight as it provided him with unlimited scope to display his ingenuity and professional talents to the utmost. German, particularly south German, watch makers of the sixteenth and seventeenth centuries were undoubtedly the world's best. They were also best suited for making the intricate wheel locks. The next best wheel lock makers came from north Italy. Thus, certain centers in Germany and Italy started to acquire special reputation as makers of wheel lock firearms. Among these were the old armor making cities of Nuremberg, Augsburg, Milan, parts of Bohemia, Suhul and the areas around Brescia, north Italy.

In the last quarter of the sixteenth century, the wheel locks were not only popular in Germany but also in countries under its cultural or political influence, and by the end of the century it was adopted by many other European nations, both for military and sporting weapons. Wheel lock firearms were in use until the mid-seventeenth century, although superior types of lock mechanisms were introduced in this period. In Italy during the sixteenth century and in Spain in the sixteenth and seventeenth centuries, wheel locks were made with exterior mainsprings along with those with internal mainsprings. The tschunkes of Bohemia had external mainsprings. About the beginning of the seventeenth century, a typical version of French wheel locks were made in which the mainspring and wheel spindle were detached from the lock-plate and the former was simply housed in the wood

of the stock, to the rear of the lock-plate, with a metal pin anchoring its apex to the stock. The wheel spindle passed through the stock and was supported by a bearing on the side screw plate. French type of wheel locks with graceful-shaped point-tailed lock-plates, but mainsprings fitted in the normal fashion were best suited for carbines and were made all over Europe, particularly in the northern regions. Many surviving examples of such wheel locks were made in the low countries – hence their classification as Dutch wheel locks.

The great sport-loving Tudor King, Henry VIII, not only procured wheel lock firearms from the continent, but also encouraged the nobility and gently of England to use them for sport. Although he forbade the use of guns loaded with lead shot by any below the rank of a Baron, it is obvious that this restriction was not enforced very rigidly in other parts of the world. Wheel locks were rarely made, probably due to nonavailability of competent locksmiths who could make them. In India, there are no surviving examples of indigenous wheel lock firearms. A few examples are held in the Salar Jung Museum at Hyderabad, of the late sixteenth century. In Germany and the neighboring countries, advanced types of wheel locks were made for sporting and target shooting guns and rifles and pistols even upto the mid-eighteenth century.

Although wheel lock pistols were superseded in the first half of the seventeenth century, wheel lock hunting guns and rifles were still in demand. Well decorated and ornamental wheel locks firearms for hunting appealed enormously to the rich noblemen and royalty to exhibit their status and interest in fine arts. However, by the eighteenth century, wheel locks were invariably simpler in design and construction, with only the lock-plate and other external metal surfaces chiseled or engraved with simple motifs. A large decorated metal plate was fitted to the doghead to conceal the jaws and to screen the flash produced in the pan from the shooter's eyes, when the priming flared. Almost all lock parts were, including the wheel, mounted behind the lock-plate. The lozenge-shaped small lock-plate, resembling that

of the flintlock, was introduced for wheel locks by the eighteenth century, just before its way out.

Although simpler and more efficient systems of ignition, such as the snaphaunce and flintlock, were introduced soon after the invention of the wheel lock, wealthy sportsmen, particularly from the Germanic countries, favored wheel lock hunting firearms until about the mid-eighteenth century. Such unusual popularity of firearms fitted with obsolete types of lock was most probably maintained due to the unlimited scope they provided the barrel maker, locksmith and stocker, in decorating and ornamenting individual pieces. Every wheel lock was handmade to the specific requirement of individual shooters, and catered for the tastes and fancies of the wealthy customer. Each wheel lock firearms was, therefore, unique. However, wheel lock firearms for military use were normally plain, or almost sparsely decorated. Nevertheless, cost alone seems to be that main deterring factor for general adoption of wheel lock firearms for military use, and restricted their issue only to some elite bodyguards and selected cavalry units.

German gunmakers monopolized the gun trade up to the wheel lock era. But the later Italian locksmiths and barrel makers excelled in the quality of their products. The wheel lock was introduced from Germany early in the sixteenth century, and the earliest known Spanish maker of wheel locks is Cristobal Frisleva of Ricla, active during the third quarter of the sixteenth century. However, no examples made by him exist and he is known only through contemporary inventories.

Madrid became the capital of Spain in 1561 and it became an important center for manufacturing firearms. Wheel locks made in Madrid by the third quarter of sixteenth century developed distinct characteristic with traces of German influence.

Probably, the most significant characteristic of Spanish wheel lock firearms is their extreme simplicity. Wheel lock firearms made for the

royalty by such renowned makers as Marquarts or Juan Slado were almost devoid of decoration. *Arquebuses* were generally small (pistols were uncommon until the beginning of the seventeenth century, and existing examples and contemporary inventories show that they seldom exceed six palms in length). Barrels were invariably octagonal at the breech and round toward the muzzle, transition being made with a ruen or decorative ring; they were normally mounted with front and rear steel sights. Surviving examples do not reveal rifling and are usually fastened to full stocks of cherry, walnut or pear, with transverse pins. A slight downward curve of the butt was broken at the small by an intended thumb rest. Instead of a butt plate, a small L-shaped steel plate protected the heel. The trigger guard was rectangular with a small spur.

The lock consisted of a flat, roughly lozenge-shaped lock-plate, rounded at the rear and mounted flush with the stock. Its centrally mounted internal wheel was protected by a raised wheel cover made integrally with the lock-plate. The V-shaped doghead spring was centrally mounted by its short lower leaf. The doghead was characterized by the peculiarly ovoid shape of its jaws, the upper of which was fixed. There was no manual safety.

Toward the end of the sixteenth century, Tipoll, in Catalonia, began to emerge as Spain's second great gun-making center. Although the wheel lock did not appear there until about the last decade of the century, its design harked back some fifty years. The Ripoli lock-plate was raised, beveled and mounted to the stock by three screws. The wheel was disproportionately small and accentuated with the deep drop of the lock-plate that provided for the action of the mainspring. In contrast to the Castilian lock with its sliding pan cover, the Ripoli pan cover pivoted and the upper doghead jaw was movable. This lock in its earliest form was fitted almost exclusively on an exceptionally long pistol known locally as a *pedrenyal*.

11.19 Wheel Lock Pistols

No surviving example of European matchlock pistol exists, although on the orient, particularly in India and Japan, they were being made until the last century and numerous examples are now available (Fig. 11.13(a) to Fig. 11.13(b)). For all practical purposes, it had not been possible to produce matchlock pistols. The difficulties of coping with a length of glowing match were such as to make it impossible for a horseman to manage such a weapon. In some early contemporary illustrations, armored knights on horseback are shown using handguns, although they are few and far between.

The wheel lock changed the situation. Locksmiths could make wheel locks in many sizes, large ones to fit into a musket, or very small to fit into a small firearm such as the pistol. Skilled lock makers were able to make wheel locks of very small overall dimensions which in turn made it possible for the gunmakers to develop firearms of miniature sizes such as the pistol.

The fifteenth century term "pistols" (pipe or whistle) were given to short and light guns. It is now generally accepted that the pistol probably derived its name from Pistola, in Eturia, Italy, where pistols were first made. One of the early Italian pistol makers was Candilo Votelli in the c. 1540. Another theory is that this weapon firearm was mainly developed for mounted use by horsemen, and was carried in holsters hung across the *pistallo*, pommel of the saddle and hence the name.

Although the earliest true pistols from the end of the third decade of the sixteenth century, the term pistol, however, does not seem to come into general use until the 1540s. The 1547 inventory of Kings Henry VIII possessions, the term *tac* or *dog* is used for the pistol. According to Peterson[232], the word *dog* was in common use in England and Scotland in the sixteenth and seventeenth centuries. This word was soon displaced in England by the fashionable pistol, but continued in common use in Scotland until the eighteenth century. As late as 1358, the inventory of Emperor Charles V's armory, known as *Relection de Valladolid*, describes pistols as *arcabuzillo de arzon*, meaning saddle *arquebuses*.

The appearance of the pistol was a very important step in the story of firearms. Now, for the first time, firearms could be conveniently used by cavalry on horseback. And so, after a lapse of a very long period the equestrian knight dared to enter the battlefield to face the musketeer, of course after arming himself with a pair of holster pistols. The few cavalry units who were armed with wheel lock pistol carried them in holsters at the saddle bow. Surprisingly, it was in France where cavalry units were first equipped with pistols by the, mid-sixteenth century.

Early pistols were invariably single shot type, designed especially for horsemen. They were carried in pairs, mounted in front of the saddle so that a cavalier could fire twice in succession. From about the 1540s, smaller pistols were produced, specially designed to be worn on the belt. From the last quarter of the sixteenth century, these pistols were occasionally fitted with a flat metal bar, the so-called belt hook, on the side of the stock opposite to the plate.

Attempts were made early to overcome the problem of reloading but it was the wheel lock which simplified matters. The pistol was fitted with an additional barrel just above the one already provided, with a centrally located metal block. The touch hole of each barrel was connected by a separate lock, operated by its own trigger. A few over and under wheel lock pistols had a single lock with two wheels operated by separate pressures on the single trigger.

Another solution to the problem of providing more than one shot from one pistol was the superimposed load. This required only one barrel with two or more touch holes and some special means of priming and firing at each touch hole. A charge of powder and ball was pushed down the barrel and a thick wad of pressed cardboard, felt or similar material was then rammed down over the charge. Another similar charge was then loaded over the first, and so on until one charge per touch hole loaded in the barrel. The charge loaded last nearest to the muzzle was fired first, and then the next

and so on until the barrel was empty. The possibility of the entire barrel going off was always present and so this system was indeed hazardous.

Yet another superimposed system was the so-called Roman candle type. These weapons had from barrel connected with a single block. One barrel was loaded and primed as usual while one of the others was charged with powder only. The two remaining barrels were loaded with a series of superimposed loads. If the weapon was now fired, the first charge exploded normally and expelled the bullet but the burst of flame was internally diverted to the powder-filled barrel and the contents of which began to burn and act as a fuse. This barrel was connected by a series of small holes to the two barrels containing the superimposed loads. As the powder burned down, these charges were fired one after, as many as thirty in one example, until the weapon was empty.

The wheel lock pistols of the late sixteenth century and early seventeenth century were generally designed to fire small diameter ball from a very long barrel. Most were highly decorated with large ball pommels and with a variety of metals inlaid in the stock. Lock-plates were large and frequently fitted with safety catches.

As the seventeenth century progressed, pistols were with somewhat shorter barrels often firing a large diameter ball. Lock-plates were usually free of the various buttons and catches and on earlier models the wheel was plainly visible. Lock-plates of the early seventeenth century were frequently covered by some form of protective cage. As the period progressed, the lock-plates were reduced in size.

The ornate decoration by earlier gunmakers was also discarded and the trend was always toward simplicity of construction and decoration. With the plainer, more basic type of pistol, coats were less and there was greater use of this type of pistol although it never became a general issue weapon among military forces.

The typical military pistol of this period had a plain wooden stock and a gently down curved butt with a slight widening at the base reinforced with a band of steel. The trigger guard, trigger and lock-plate were also of plain steel with the wheel more or less completely enclosed. Barrels had an octagonal breech but changed to the circular section about a third of the way along their length of some 14 inches. A slim ramrod was housed below the barrel.

By the mid-seventeenth century simpler, cheaper systems of ignition were replacing the wheel lock and soon it was abandoned for pistols, although it remained in use on long arm until the late seventeenth century.

In the sixteenth century, most wheel lock pistols tended to be very elaborate and highly decorative. Many gunmakers favored a lock with an acutely angled butt terminating in a large ball pommel, the whole surface being inlaid with horn ivory or metals. The ball afforded the horseman a reasonably good means of grasping and drawing the pistol from the holster.

Initially, wheel lock fitted to pistols were generally of the type fitted to contemporary long arms, excepting that they were miniaturized versions. There was no standardization of calibers and barrel lengths of pistols. All normal examples had fairly short barrels and large in relation to the general proportions of the pistol. For the first time, a large number of pistols were made completely of metal although some were fitted with wooden butts.

Wheel lock pistols were expensive and, therefore, issued only to selected cavalry units. German wheel lock pistols were fitted with heavy lock-plates and without stinting the materials. The wheel was generally covered and the mainspring mounted internally. Barrels were normally made in two stages, having a rounded muzzle and an octagonal breech. Later, the characteristic angular shape became peculiar to German pistols.

Gunsmiths of the German town of Nuremberg, the most important center for arms production in Germany, incidentally for production of watches and clocks, produced wheel lock pistols of superb quality, precision and

workmanship. The Bijou wheel lock examples (Fig. 11.13(b)) of the sixteenth and seventeenth centuries are typical due to their superb worksmanship. (Augsburg of German was another large center for firearms production and some richly decorated works from this center are extant.)

During the Thirty Years War, 1618–1648, demands for firearms in general, and pistols in particular, increased enormously. Although pistols of this period were well made, those made for military use were seldom decorated. Many examples of wheel lock pistols of their period had wheels which were automatically spanned when the doghead was raised fully and then lowered to the firing position, thereby eliminating the necessity to span the lock with key.

Mostly German gunsmith produced the best wheel lock pistols, and the Brescian gunsmiths who flourished in the Val Trompia (North Italy), were the next best. While the German examples are heavy, bulky and frequently overdecorated, the Brescian examples are distinguished by practically the opposite characteristic, lightness, compactness and elegant sober decoration.

Brescian gunsmiths of the late sixteenth century made some functional wheel lock pistols with nearly lozenge-shaped lock-plates, which became the characteristic feature of the famous Brescian pistols of the seventeenth century. The French lock-plate differed from the German and Brescian ones, in that the internal mainspring was extended along the stock and the use of gold to decorate the barrel and the bridge at the butt plate. A typical Brescian pistol of the early seventeenth century was the Rotino, which became very famous and popular. It had a long small calibered and light barrel, and was strong. In the sixteenth century, the doghead of Brescian pistols was of angular shape.

Ripoli pistols are characterized by their peculiar ornamentation, all parts being decorated *en suite* with chiseled *arabesques* even to the stocks, usually sheathed in steel or brass. Barrels were pin-fastened; the tang screw was an

extension of the trigger guard, usually made with a spur. Belt hooks were common.

The wheel lock *pedrenyal* lasted until ca.1615. Its barrel, between two and three palms long, octagonal at the breech with no abrupt change to round toward the muzzle, was sometimes fitted with a rear sight. The stock terminated in a small fishtail butt. Later wheel lock pistols had shorter barrels with no sights; the transition from the octagonal to round was made with half-ring or indentation. Their locks usually equipped with manual safeties, and their trigger guards were normally without the spur. Instead of the fishtail their butts were spherical, the hall mark of the Ripoli pistol until the nineteenth century.

Wheel lock pistols were of practical use value for mounted use and wheel lock long guns for sport. This brought about a change in the use attitude of the royalty, nobility and the landed gentry toward firearms as implements of war and sport. From about c. 1530 onward, there was a steadily increasing demand from the upper classes for fine-quality longarms, carbines and pistols. Henceforth, the gunmaker was assured of the kind of patronage that made it possible for him to develop his trade along more advanced lines.

The appearance of the wheel lock brought changes in warfare and in social history as well. Pistols were now practical, and this brought a change in the armament and tactics of many cavalrymen, especially the German Reiters. It was possible for a gun to be kept fully loaded and ready for instantaneous discharge, and this brought problems unknown with the earlier matchlock, in which the presence of a smoldering match always indicated that a weapon was capable of being fired. In this connection, it is interesting that one of the first documents to mention the wheel lock is an account of an accident in which such an arm went off unexpectedly. The gun could now also be carried as a concealed weapon, and crimes of violence involving wheel locks became so prominent that rigid laws controlling their use were promulgated in many cities of Austria, Italy and England during the early 1500s.

The wheel lock was far more efficient and versatile weapon than the matchlock. Because of its complexity, however, it was also far more expensive and greater skill was required for repairs. For these and lesser reasons, it never supplanted the matchlock as the standard weapon for infantry. Both ignition systems were used side by side, along with the various flint arms, until the true flintlock superseded almost all other types, late in the seventeenth century. The wheel lock pistol lasted through the sixteenth century, upto the middle of the seventeenth century, by which time it was becoming obsolete. It proved fairly reliable, but gunsmiths were already looking for simpler, cheaper and more efficient system of ignition.

11.20 Influence of Wheel Lock Firearms in Warfare

Introduction of the wheel lock enabled the shooter, for the first time, to keep his weapon ready after loading, priming and spanning, ready for instant use. It was also possible for him to leave the weapon in this condition safely for prolonged period which was not possible with the matchlock. By eliminating the requirement of a smoldering match, a shooter's whereabouts and movements, particularly at night, could not be detected either by the game he is stalking or by the enemy he is after. Wind and weather did not affect adversely the performance of a wheel lock. His shooting was more accurate as he could concentrate on the target to a greater extent.

However, until the first quarter of the sixteenth century, wheel lock firearms were considered hazardous by the royalty and nobility. In 1517, Emperor Maximilian I of Bavaria banned the use of wheel lock within the Hapsburg territories and in 1518 he extended this embargo to his entire empire. The Duke of Ferrara, Italy, issued an ordinance in 1522, which forbade carrying of wheel lock firearms in the streets of Ferrara. Maximilian refers to them as self-stricking guns, and Duke of Ferrara as stone-fired guns. Presumably, the wheel lock gun was considered an ideal weapon for an assassinator, as it could be safely carried concealed after fully loading it,

something impractical with the matchlock. Fortunately, this attitude did not last long and wheel lock firearms because it was very popular on the continent, as well as in England. Princes viewed the wheel lock with apprehension for it made the assassin's task much easier as he could now prepare the weapon and conceal for instant use – something impossible with the matchlock.

On most combination weapons there was no attempt to disguise the fact that the weapon was dual purpose, but some did have the pistol section cleverly concealed. Gunsmiths often mounted small wheel lock pistols on other weapons such as swords, maces, axes and even halberds. Triggers were usually set well back along the shaft and were usually in the form of a button or rod. One was a sword-stick pistol. Here, an apparently ordinary stick of the seventeenth century concealed a long-bladed sword which also had a small wheel lock pistol fired by a tiny trigger. Even stranger was a crossbow fitted with a wheel lock pistol.

11.21 Stocking Styles of Wheel Lock Firearms

Wheel lock firearms offered stock makers splendid opportunities in the way of designing and fashioning stocks to suit the tastes of individual customers and cater for the shooting styles of sportsmen of different countries. For instance, wheel locks long guns were stocked with check butts for the shooters, shoulder butts for the Spaniards and chest butts for the French. So many different types of stocks were developed that it is an exaggeration to state that every conceivable from of stock that could be fashioned was fitted.

11.22 Stocks of German Wheel Lock Long Guns

In the early sixteenth century, wheel lock long guns were fitted with stocks, having the so-called butt, of the matchlock period and by the second quarter of the century two typical versions of this type of butt started developing (Fig. 11.14(a) to Fig. 11.14(f)). The more popular of the two, commonly known as the German butt, was thick short and set with an even, but slight

from the rear end of the barrel to the heel of the butt, almost in line with the barrel. The characteristic feature of this butt, introduced before 1550, was the cheek rest or cheek piece on the left hand side. On the right hand side of the butt a small incised compartment, the so-called patch box, with a sliding shutter was provided, which by 1580, held some accessories of the gun, such as the spanner nodules, pyrites and so on. It was also very handy to keep small greased lines patches in which the bullets were wrapped before ramming down the barrel.

The second type of butt, the semi-rounded butt, was thick and heavy with a slightly widened butt end and terminating in a broad toe. This type of butt enjoyed only limited popularity and is invariably found on examples of military long guns of the first half of the sixteenth century. A modified version of this type of butt, the paddle-shaped butt, was fitted to German wheel lock muskets and carbines of the period c. 1620 to 1660. It was also heavy and flat, with a straight upper edge and a rounded butt end. An improved version of the paddle-shaped butt ending in a scroll-shaped butt end is found in the models of long guns made for Archduke Matthies, later the Holy Roman Emperor (1612–1619).

In the second quarter of the sixteenth century, the cheek rest was gradually deepened and ultimately it extended well below the lower edge of the stock. The upper edge of the stock distinctly dropped, just behind the breech, and then followed parallel to the line of the barrel.

In about 1600, the upper edge of the butt developed a steep fall just behind the breech of the barrel, and the comb of the butt continued to the rear almost horizontally. The thumb of the grip-hand was thus removed from the line of sight, as the butt was rather narrow. The downward-lengthened cheek piece now became the rule. This type of stock remained in use as long as the wheel lock was in use and after 1650 it became less common, and before 1700, it had almost disappeared. During its last 50 years, it was almost exclusively used for rifles.

The above-mentioned types of stock were not intended to support the gun against the backward force of recoil. However, when they could be used, it was simply due to the fact that the charge and caliber were adjusted to the weight of the gun. The heavier and larger the caliber and the charge that could be used without uncomfortable recoil.

11.23 Stocks of Spanish Wheel Lock Long Guns

As demands for military long guns increased, the requirement of greater penetrating and stooping power of the bullet arose (Fig. 11.15(a) to Fig. 11.15(c)).Thus, the charges and calibers had to be increased, which in turn resulted in the increase or recoil. To counteract this force, the total weight of guns had to be increased and the only major components which could be made with greater weight were the barrel and stock increasing barrel weight was achieved mainly by increasing its length after taking into consideration many other factors. This increase in weight to be component by an adequate increase of its stock to balance the whole gun. The easiest way to increase the weight of the stock was to increase its length, and so the stock was extended backward and when the butt length could not be extended any further it was bent downward. Thus, instead of the butt resting against the cheek, as in the case of German wheel lock stocks, it could now be pressed under the armpit or toward the right side of the chest.

By the end of the sixteenth century, Spanish wheel lock muskets were fitted with the fishtail butts. By the early part of the next century, however, the fishtail butted stock was modified with the lower edge curving down gracefully and terminating in a blunt toe – the Catalon, Castilian or Spanish stock. This type of stock became very popular in European armies from 1550 to 1580, and with some minor improvisations it was in use in Spain until the mid-nineteenth century.

11.24 Stocks of Sardinian Wheel Lock Long Guns

Stocks of Sardinian wheel lock long guns show distinct Spanish influence(Fig. 11.16(a) to Fig. 11.16(h)). They were fitted with fin shaped with a straight and prominent comb and a convex edge. The butt was invariably fitted with a marked downward angle to the line of the barrel. It is a modified version of the stock fitted to Lambard *arquebuses* of the second half of the sixteenth century. A triangular attachment to the straight upper face is fashioned to facilitate the shooter to hold the stock in the firing position with the comb to his cheek. The forestock was made as a separate component and was usually overlaid with plates of brass, iron and silver. The salients of the wooden butt were also similarly ornamented. Carbines and rifles were most probably stocked by the local stockers and decorators.

Stocks of Dutch Wheel Lock Long Guns

During the mid-sixteenth century, the Dutch introduced a type of stock with a butt resembling a truncated, with incurved top and bottom edge and a prominent comb (Fig. 11.17(a)). The butt was sent a marked bend, fitted with a cheek piece, and a prominent thumb-notch. This type of stock became very popular and was adopted by the other European nations. By the beginning of the next century, it ultimately replaced almost all other types of stocks for muskets.

11.25 Stocks of Italian Wheel Lock Long Guns

Fig. 11.18(a) to Fig. 11.18(e)

11.26 Stocks of French Wheel Lock Guns

Fig. 11.19(a)

11.27 Stocks of Wheel Lock Pistols

Fig. 11.20(a) to Fig. 11.20(c)

Examples of wheel lock pistols made before c. 1540 are normally fitted with a miniature version of the oblong German butt, some of them fashioned with grooves to offer a firm hand-hold to shooter's grip-hand. Another early type of butt fitted has a narrow grip with the rear portion

slightly flared and the butt end terminating in various styles. By about c. 1550, the general trend was to fashion on almost straight stock in line with the barrel, and having a slender and graceful butt. This type of stock appears to be used up to about c. 1640.

Butt ends of wheel lock pistols were fashioned in many ways, such as the goat's foot, fishtail and pommel. Among these, the pommel types appear to be most popular and the goat's foot type the least used. Shaped and sizes of pommels used also varied considerably. Some typical shapes found on surviving examples are rounded, polygonal, ball with front and rear ends flattened (commonly found on German wheel lock pistols from c. 1560), pear, elongated oval and others. The pommel afforded the horsemen a good means of drawing the pistol from the holster. Pommels were normally made with the some material where the rest of the stock was made.

In the latter half of the sixteenth century, another unusual form of stock was fitted to wheel lock pistols with straight grip which was usually set at a slight downward angle to the line of the barrel. The general trend was to increase the drop gradually, as the century progressed, until it became acutely angled to fit a large ball pommel, which became a characteristic feature of the German wheel lock pistols. The ball was not intended for use as a club, but was merely a convenient means of drawing the pistol from its holster.

By about 1580, a long and slender wheel lock pistol of comparatively small caliber was introduced, most probably for the first time in France. It was stocked with a butt of a type in vogue in France, excepting that it was straighter and sloped lesser, with a few butts curved slightly, and terminating in an elongated oval, or pear-shaped pommel. It was either hollow or made of very light wood. Another popular type of butt introduced in France in the early part of the sixteenth century and sued until about the mid-seventeenth century was also straight but flared toward the rear and the butt end sheared off straight.

On the continent, in the third decade of the sixteenth century, yet another popular form of pistol stock made its appearance. It curved downward prominently and widened prominently toward the bottom end where it was cutoff straight. Initially, the butt end was lengthened with a metal ring, but by about 1640, the ring was replaced by a metal cap – the butt cap – with two spurs extending on either side of the butt (grip). The lengths of these spurs were increased gradually, as the century progressed, and by about 1680, they covered nearly the entire length of the grip. This type of butt remained in use as long as wheel lock pistols were in use.

Yet another popular type of stock was almost straight terminating in a small, six-sided hexagonal pommel. Since the lock-plate was fairly large, the stock had to be hollowed out to receive it. This naturally tended to weaken the wood and some German makers overcame this problem by making pistols with all metal stocks. This type naturally, tended to be plainer then those with wooden stocks.

Wheel lock pistols of the late sixteenth century were often ornate with acutely angled butts with a large ball pommel. The ball was not intended for use as a club but merely as a convenient means of drawing the pistol from the holster. It was either hollow or made of very light wood, and as most of the pistols were decorated, few owners were likely to damage their prize pistol by hitting somebody with it.

11.28 The Snaphance or Snaphaunce or Snaplock

There were numerous snags with the wheel locks (Fig. 11.21(a) to Fig. 11.21(i)).First, it was mechanically and beyond the capability of any but the highly skilled locksmiths to make reliable wheel lock. Second, rust or grit easily jammed the mechanism, springs broke and chains snapped, quite often when least expected or desired. Such stoppages required the services of expert armorers to repair, perhaps it was also less reliable than the sturdy and simple matchlock. They were not readily available on the battlefield.

Third, the lock time or hang fire, that is, the interval from the time the trigger was pulled to the time projectile left the gun muzzle, was too long, which normally resulted in bad shooting. Last, wheel lock firearms were very expensive to produce and so could not be generally issued firearms for the fighting elements of an army. It was also beyond the reach of an average sportsman. Due to these reasons, gunmakers, particularly those of the non-Germanics countries, were keen to develop a simpler, cheaper and more dependable system of ignition acceptable for both the soldier and sportsman. They soon succeeded in devising a system of ignition, the snaphance or snaplock which eliminated many of the snags encountered with wheel locks.

Although the wheel lock and snaphance were contemporaneous, the exact origin of the latter is not yet certain. However, according to Peterson[233], in the middle of the sixteenth century, the snap lock makes its first appearance in the Scandinavian countries, the earliest being 1547 (Sweden), 1562 (Norway) and 1565 (Denmark). It is generally known that the snaphance was introduced in about 1550, and snaplocks were being made in Sweden by a number of gunmakers in Sweden, both Swedish and immigrant Ferms. This lock is mentioned for the first time in two documents of 1547, one Swedish and the other Italian (Florentine), which made some arms historians to believe that the snaphance must have been invented either in Sweden or in Italy. The Swedish document mentions it as *snapplas* (snaplock), while the Florentine ordinance mentions it as *archibusi da fucile*. Some early German records also mention *der Spanische schnappschloss*, presumed to mean Spanish snaphance, which led some early writers on firearms to assert that the snaphance was invented in Spain.

The name snaphance, however, appears to have derived from the Dutch, or Flemish, word Snap Hann or Snappen, for Snapping Pen. Some writers ascribe the name to a Dutch translation of the word meaning chicken thieves. They believed that the snaphance was developed by thieves (poachers) who could not use the matchlock gun as the glowing slowmatch

betrayed their nocturnal adventures, and they were also too poor to afford the expensive wheel lock gun. This hypothesis naturally led to the Dutch (Low Countries) origin for the snaphance. However, the generally accepted explanation is that the name merely signified the jerky and snappy manner in which the cock of the lock moved down after striking the steel.

11.29 Working Principles of the Snaphance-Lock

Basically, the snaphance-lock, as was also the case with the wheel lock, struck sparks by friction between a piece of flint and a strip of steel to igniting the priming. However, the wheel, chain and the nodule of pyrites of the wheel lock were disposed with two simple steel arms and were substituted. One of these arms – the cock – was a curved steel piece, fitted at the end with a pair of jaws which could be tightened to grip a piece of sharpened flint between them. The other arm, the hammer also a curved piece of steel, was specially shaped and made of tempered steel attached to its upper end. Both the cock and hammer were pivoted to the lock-plate, the flint and steel faced each other with the pan located between them. When the hammer was lowered over the pan, the steel stood vertically over the rim of the covered pan.

When the cock was pulled fully back to the position, the tail of the cock pressed fully down on one leaf of a V-spring, the mainspring, and the pointed end of a transverse sear of the matchlock variety was pushed out of a hole in the lock-plate by the action of a sear spring to hold the base of the cock and locked the cock in this position. A pinch of priming powder was placed in the pan and a spring operated cover was pushed to cover the pan. The hammer, or steel arm, was then lowered until the steel stood vertically over the pan.

To fire the lock, the pan cover was released manually and the spring pushed it open. When the trigger was pressed the head of the sear retaining the cock withdrew laterally and released the cock and the cock fell forward

by the force exerted by the mainspring as it decompressed. The flint struck a glancing blow against the top of the steel and slided down the face of the steel in a grating motion. The jerky impact of the flint against the steel struck sparks which fell into the pan and ignited the priming.

The snaphance contained very few moving parts and so it was much simpler, cheaper to make and easier to repair and maintain them the wheel lock. Initially, the snaphance-lock was usually combined with either a matchlock or wheel lock, both mounted on the same lock-plate, so that either could fire the piece. It is rather surprising that even though the snaphance was simpler and cheaper than the wheel lock, it was never very popular in Europe and survived only in north Africa until the nineteenth century in the form of seventeenth century Dutch lock made in Liege factories. Nevertheless, many wheel locks firearms were modified, particularly pistols, by fitting the steel arm (hammer) front of the doghead and removing the wheel, chain and other unwanted parts. Surviving examples of these converted snaphance-lock firearms still retain the characteristic lock-plate with a nearly circular potion at the center against which the wheel was mounted.

11.30 Early Snaphance Long Guns

Scandinavian snaplocks may be grouped mainly into two groups – the Swedish and Norwegian types. On the Swedish type, the upper jaw of the cock is mortised, and later dovetailed at the back into the very short neck, while the Norwegian type has an upper jaw ending in a guided pin through a hole in the power jaw. A third type, the Baltic lock may have developed from the Swedish type, in which the upper jaw is formed as a leaf wrapping the neck of the cock.

It is generally accepted that the characteristic feature of the true snaphance-lock is that the pan cover and steel are made separately and mounted independently. However, in the course of its development the lock was modified in many ways, and one of the fairly early modifications was to

combine the pan cover and the steel into a single component. And in its final form, the laterally acting sear, often projecting through the lock-plate, was replaced with a vertically operating sear which engaged a notch cut on the tumbler. Shaped metal plate was mounted on the cock spindle. These locks naturally do not fall either under the classification of true snaphance or flintlocks, but due to the lack of any other generally accepted nomenclature for these locks they are here under the classification of snaphance-locks.

One of the advantages of the true snaphance-lock was that it had a built-in safety device. After loading and priming the piece the steel, which was independent of the pan cover, it could be moved out of reach of the cock rendering the firearms safe to carry. However, when the lock was subsequently removed the pan cover uncovered the pan as the cock falls, which eliminated the possibility of the shooter forgetting to uncover the pan manually before pressing the trigger – resulting in a miss. But if the cock fell accidentally while the steel was still in the safe – out of reach – position, the linkages operating the automatic opening system of the pan were actuated and the pan – cover moved out which normally resulted in the loss of the priming powder which rendered the piece temporarily out of action.

The oldest surviving example is a snaplock gun in the Royal Armoury (Livrustkamm), Stockholm (No. 1311). It is said to be one of the thirty-five *harquebuses* fitted by the royal order with snaphance at the Swedish Royal Armoury, Arboga, in 1556. The barrel of this example is stamped with Nuremberg marks, and fitted with the German oblong butt. It is not possible to ascertain whether the snaplock fitted to it is of Swedish origin or merely a reproduction of the earlier German version of the snaplock. During this period, many immigrant German gunsmiths were used at the Arboga armory and there is a possibility that they made this type of lock on the German pattern, familiar to them. In this, as in all Swedish snaplocks prior to about 1650, the mainspring is placed on the outside of the lock-plate, working from beneath on a spur of the cock. The free end of the spring acts

on the steel, which is separately from the now missing pan cover. The jaws of the cock were rather long with short tips bent slightly downward.

Many improvisations were applied to the Swedish snaplocks. They are first, a triangular bridle covering the spur of the cock, and a sort of extra pan cover growing out of the reinforced lower rim of the wheel. Second, inside the lock-plate, the sear is located between two studs, more often, in a U-shaped mounting. Later, the sear is divided into two members, a spring with a lug protruding through the lock-plate and a sear proper removing the lug when the trigger is pressed. As the steel cane is laid forward, this makes the lock safe, these are not half-cock. Third, full-cock is established by the end of the Z-shaped sear protruding through the lock-plate over the spur. Last, in the seventeenth century the variation has a steel attached to the pan cover like the steel of the flint lock, but so that the steel proper may be turned at a right angle to the barrel, thus making the lock safe without uncovering the powder. While the older Swedish snaplocks have a cock with jaws at right angles to the neck. The whole cock later became curved. By about 1650, most snaplocks of the Swedish type had interior mainsprings, acting downward on the toe of a tumbler connected with the cock. Locks with steel of the swing-out type and with steel and pan cover separated are equally often found. At the same time, the lock-plate, which originally was almost rectangular, became more curved, and, at last on locks made by gunmakers in the towns, often with a pronounced concave lower edge.

The snaplock was very popular in Sweden during the entire seventeenth century, while the wheel lock placed only a very unimportant role. Even sporting guns of high quality ordered in Paris by Swedish noblemen were occasionally made with snaplocks of the type, normally unknown to the French gunmakers. As late as the first half of the nineteenth century, snaplock guns were made by the town gunmakers of Sweden, although the flintlock became more and more predominant. In the country, and especially in the north of Sweden, the snaplock was in use well into the nineteenth century, and on some small island in the Baltic even after 1900.

On Swedish snaplock muskets from the Thirty Years' War, rocks both with swing-cut steel and the separate steel are found. On most models, the jaws screw was formed as a ring. As late as 1688, a snaplock musket was introduced in the Swedish Army. This Model 1688 had steel and pan cover in one piece, as did the ordinary flintlock. The mainspring, also serving as a spring to the steel, acted downward upon the toe of the cock. Half-cock was made by a projecting stud under the toe, full-cock by a square projection over the spur.

The Swedish snaplock was also made in the Norwegian and Danish boarder provinces. A special type was developed in the Danish – Swedish border land of north Scania. The most conspicuous of this was a cock's comb with an intricate perforated pattern on the back of the upper jaws, and very often also a star-shaped middle the spur, decorated with corresponding perforations. Frequently, the combined mainspring and steel spring has a bend round the foremost lock-plate screw, a feature also now and then found on Swedish early seventeenth century locks.

The Swedish-type snaplocks found in Norway may be of Swedish manufacture, although it is more probable that they were made in Norway. Very few of them have maker signature or dating, but no doubt they were made at least as late as those in Sweden.

On the other side of Sweden, too, the Swedish-type snaplock was copied. The locks made in Finland, the part of Sweden, differ only in having the cock screw placed further back than the Swedish locks. In the Baltic provinces, which also belonged to Sweden until 1721, the special variation called the Baltic lock was made. Its cock has been discussed in the beginning of this chapter. Generally, the lock-plate was of wheel lock type, ending at the back as a leaf. Late examples (from the second half of the eighteenth century) were much curved. The steel was almost always of the swing-out type.

Just as the Swedish type did, the Norwegian type snaplock also probably came from Germany, where snaplocks with the same construction of the upper jaw of the cock are occasionally found, and most dating from the last quarter of the sixteenth century. It is significant that the first mention of the snaplock in Norway refers to guns sold by the corporation of German merchant in Bergen. As the Norwegian troops throughout the seventeenth and eighteenth centuries in most cases got their equipment from the central arsenal in Copenhagen, which was used by both the Danish and Norwegian armed forces, the Norwegian snaplock may also have been influenced by those used in Denmark.

Besides the form of cock, two other features are characteristic of the Norwegian type of snaplock. One is a sort of fence on the pan, developing in a shell pattern. In late town-made guns this shell may appear as a cartouche. The other feature is a special form of sear. Like the Swedish, this sear is two-membered, but the branch of the sear acting upon the sear spring is shaped like a ring. The sear does not pivot around a vertical pin but is kept in position by a tiny bridle. This last feature is not found in all locks of the Norwegian type. The steel could be either the swing-out type or the type separated from the pan cover, with a preference for the latter.

The peasants of Norway, being woodsmen, soon took a liking to the snaplock which was then produced by clever country blacksmiths or even by peasants themselves. Already in 1591, the commandant of the Castle of Akershus ordered fifty snaplock long gun's, and a little later the national defense forces were permitted to serve with snaplock guns instead of wheel lock guns, because they were more used to the former. Owing to the conservatism of the peasants, there was hardly any development of the snaplock throughout the seventeenth and eighteenth centuries. The existing specimens include only a very few town-made snaplock guns, probably because in the town the flintlock soon gained upper hand over the snaplock among the Lapps of the far north of Norway, snaplock guns survived, almost to our own day, frequently transformed into percussion locks.

In Denmark, as mentioned above, the snaplock is known to have existed from the same time as in other Scandinavian countries. Although it never acquired the same popularity of the wheel lock and the later flintlock, we find it frequently mentioned in literary sources. Of about 18,000 guns in the Copenhagen arsenal in 1609, one-third was snaplock, while they were only very few of these fifty years later. It is, however, a curious fact we do not have any snaplock gun from that time which can be proved to be Danish. Some few guns with stocks that seem Danish have early snaplocks of the Swedish types with the jaws almost at right angles to the neck of the cock. Several of them have a curved finger-grip in one piece with the upper jaw, a feature not known to any proved Swedish snaplock. But what the Danish snaplock really looked like is still an open question (A.H.).

11.31 The German Snaphance

In Germany, the snaplock did not gain as much popularity as it rightly deserved due to the fact that almost all German shooters were great admirers of the contemporaneous wheel lock (Fig. 11.23(a) to Fig. 11.23(e)). However, it is generally believed, although there is no positive proof, to have come from north Germany and may be at first in the form of arms support from Lubeck to the Swedish rebel leader Nils Dacke in 1542.

There are reasons to believe that snaphance-lock firearms were made in German yearly in the sixteenth century and they were adopted in the low countries, England and Scotland. But the earliest examples of German snaphance surviving are of the last quarter of the sixteenth century.

Some examples of German snaphance long arms are available in Dresden, Coberg and Munich museums. These muskets are fitted with matchlocks also of the simple under lever type. The cock spring is fitted to the lock-plate internally and bears in a notch cut on a tumbler mounted to the cock spindle behind the lock-plate, indicating that these locks are of the advanced type. When the cock is pulled back fully, a laterally acting spring-loaded sear engages the tumbler and held the cock in the full-cock position. The steel is

fashioned like a segment of a wheel, of the wheel lock type, and is pivoted outside the lock-plate. The long under lever of the matchlock, mounted on the same lock-plate, is fashioned in such a manner that it encircles the small trigger of the snaphance-lock and also acts as the trigger guard.

The mechanism installed to operate automatically the pan cover is of interest. The cover is of the sliding type and is pivoted to a springy lever. When the cover is shut, against the action of the spring, it is held by a hook at the end of another lever, fitted horizontally across the lock-plate. The other end of the lever rests the cock. When the cock fell it pushes this end of the lever, in front of it, moving the other end in the opposite direction causing the release of the lever of the pan cover and so uncover the pan: The release mechanism is fitted outside the lock-plate, and between the cock and steel. This system of opening the pan appears to be modified further with the lever of the cover placed behind the lock-plate and push forward by a bar connected to the top of the tumbler, which pushed open the cover when the cock fell.

This system of automatically opening the pan cover was also adopted in the low countries. The inclusion of a tumbler in the lock mechanism was one of the main improvements to develop the snaphance-lock later.

The Dutch version of the German snaphance-lock has a flat S-shaped cock with either a prominent toe or heel, at its base. A literally acting spring-loaded sear protrudes through the lock-plate and holds either the toe or the heel, as the case may be, to provide the full-cock engagement. The steel is attached to a flat arm bent either at a sharp angle into a pronounced curve. A circular or square end cover, or side guard, or fence, is fitted at right angles to the outer edge of the pan.

11.32 The Baltic-Lock

The simplest form of the snaphance-lock was the Baltic-lock, so called because it seemed to have originated in that area of Europe. In an early version of it the cock holding the flint was long upper hook, gracefully

curved and terminating in a slender, long and adjustable jaw. The base of the cock is fashioned to form a short toe, pressing down on an external mainspring, and an elongated heel and when the cock was pulled back to the full-cock position it was locked by the nose of a spring-loaded sear fitted on the inside or the lock-plate with it protruding through a hole in the lock-plate. The same mainspring also served to supply tension for the arm which was fitted with the steel. When the trigger was pulled the nose of the sear withdrew internally and released the cock to strike the steel as the mainspring decompressed.

The steel of rectangular-shape was attached to a long and straight stem pivoted to the lock-plate. When the arm was lowered, the steel rested vertically in front of the cock and over the pan. Though the steel is normally fitted with a separate spring it is not unusual to find the mainspring serving both the cock and steel. The pan cover could be opened and shut manually. There is no half-cock position.

In the early forms of Baltic-locks, the jaws were set at an angle to the stem of the cock. But in the second half of the seventeenth century, they were elongated into a smooth and continuous curve along with that of the short stem of the cock. This typical shape of the cock, somewhat resembling the claw of a crab, remained unchanged until the end of the eighteenth century, and remained a characteristic feature of all Baltic-locks.

The Baltic-lock was widely used in countries bordering the Baltic Sea, hence its name. Although it could not be definitely established that the snaphance-lock originated in the low countries, the probability is that it was introduced and reproduced by the immigrant German gunsmiths employed in Sweden, with the German version as their model. Variations on the snaphance evolved in the Mediterranean area and a Spanish and an Italian version resulted, although the basic deference is in the manner in which the mainspring acts on the toe of the cock.

11.33 The Italian Snaphance – The Italian-Lock

The earliest reference to snaphance firearms appears in the Italian (Florentine) ordinance of 1547 (Fig. 11.25(a) to Fig. 11.25(e)). They were in general use in Italy by the latter half of the sixteenth century. An early type of Italian-lock introduced in the second half of the sixteenth century had an external mainspring acting down on the toe of the cock. And by the last quarter of the century many Italian-locks were fitted with internal mainspring attached to the lock-plate. In this type of lock, the mainspring acted on a specially shaped metal plate – the tumbler – mounted rigidly on the cock spindle. When the cock is pulled back fully, one end of the sear projected through a hole in the lock-plate and engaged either a notch cut on thinner surface of the cock, or spur on the hell of the cock, to give the full-cock position. At the same time, the mainspring was compressed by the rotating tumbler. The steel arm was held over the pan when lowered by a separate spring. When the trigger was pressed the sear withdrew laterally and released the cock. The mainspring decompressed, rotated the tumbler and so activated the cock to strike the steel.

11.34 The Roman-Lock or The Italian Toe-Lock

As early as c. 1580, in Italy (Fig. 11.26(a) to Fig. 11.26(h)), the steel and pan cover of the snaphance were being made as a single component, and this modification was adopted in the Western Europe by about c. 1650. However, the true snaphance-locks were also made in Italy, with separate steel and pan cover, up to the beginning of the nineteenth century.

The I Italian snaphance-lock was modified by incorporating the frizzen, perhaps to cater for the Spanish tastes, and was in use until the early nineteenth century. It appears that this type of lock was then known as the Roman-lock, or Italian Toe-lock, though it is generally classified with the Spanish-lock (IIave Espaniola) which is now known as the *miquelet-lock*.

In the *Roman-lock*, the mainspring is fashioned with its upper leaf forming a hook which pressed down on the toe of the cock. The base of the cock has a heel which is held by a horizontally acting sear protruding through the lock-plate in the full-cock position.

In some very early versions of the Roman-lock, the cock is caught in the half-cock position by a manually operated catch the dog – which hooked on to the tail of the cock. But as early as c. 1600, a subsidiary sear was introduced which passed through the lock-plate, under the toe of the cock and held it automatically when it reached the half-cock position. In some sophisticated versions of the lock produced later, the sear consisted of two levers the front one engaging the toe of the cock to give half-cock safety position and the rear lever engaging the heel in the full-cock position. A strong V-spring acted on both these levers from within. When the trigger is pressed while the cock is held in the half-cock safety position the lever engaging the toe did not release the cock, whereas when the cock is held in the full-cock position pressure on the cock withdrew both the levers and the cock was released. The mainspring, mounted externally, exerted a downward pressure on the toe of the cock. This system was in use as long as the Spanish miquelet-locks were made.

11.35 The Florentine-Lock or Brescian-Lock

The modified version of the Italian-lock – the Florentine or Brescian-lock – was made in Tuscany and Emilia (Brescia) (Fig. 11.27(a)). The characteristic features of the lock were its elegance of execution and intrinsic fragility. It is neat, light and of excellent construction. These locks were obviously fitted mainly to specially made sporting weapons for wealthy customers and presentation firearms, and were not intended for military use.

Although the snaphance-lock was inferior to the contemporary flintlock, it was made in Italy, particularly in Tuscany, until the beginning of the nineteenth century. Italy being a major producer of firearms which were exported to many countries on the continent, the Italian gunmakers could

not ignore the Spanish tastes mainly because Spaniards were one of their major customers. It is also a fact that Spanish exercised political supremacy over south Lambardian, Napolitan and Brescian gunsmiths. Consequently, Italian gunsmiths produced not only their Roman-and Italian-locks but also Italian versions of the Spanish miquelet-locks. Mechanically both were very similar but the Italian miquelets were usually richly decorated and ornamented. Particularly, the ones made in Brescian snaphance (miquelet) hand firearms were famous for their superbly engraved steel components such as barrels, lock barrels, lock-plates, triggers, trigger guards and so on, following mainly the baroque tastes of the period.

11.36 The Turin-Lock

By about c. 1580, the metal hook – the dog or dog catch, was fitted for the first time in a type of Italian-lock, generally known as the Turin-lock (Fig. 11.28(a)).The dog was screwed to the lock-plate behind the cock. When the cock is pulled back, and before it reached the full-cock position, it held the tail of the cock, or in some later versions a notch cut in the rear edge of the cock. As the catch is applied it manually, it did not get disengaged when the trigger was pulled. When the cock was pulled further back to the full-cock position, the catch permitted the cock to move backward and at the same time a small spring attached to it kept it away from the cock so that the fall of the cock was not arrested by the dog catch.

11.37 The Maldo-Wallachian Snaphance-Lock

This type of miquelet-lock was made in Italy mainly for expert to Eastern Europe, the Balkans, south Russia and Turkey (Fig. 11.29(a) to Fig. 11.29(b)).It was more or less similar to the Roman-lock but the pivots of the cock and steel arms were joined together by a metal plate – the so-called apron. It covered the mainspring either fully or partly, and also rendered the lock more sturdy.

11.38 The Spanish-Lock or The Spanish Miquelet-Lock

Some Spanish records of the early sixteenth century mention the snaphance-lock for the first time as IIave Espanola – the Spanish-lock – but these locks fall under the general classification as miquelet-locks (Fig. 11.30(a) toFig. 11.30(f)). This type of lock was most probably developed from the sixteenth century Italian-lock of 1580. However, the Spanish miquelet has made its first appearance during the second or third decade of the seventeenth century. The name miquelet, however, appears to be derived from the Spanish (Catalonian) word *miquelete*, by which the irregular mountain troops of Catalonia (Spain) were armed with guns fitted with this type of snaphance-lock. The miquelet soon became popular and almost immediately replaced the wheel lock in Madrid and Ripoli.

The Spanish miquelet-lock is very distinctive, has a strong mainspring mounted on the outside of the lock-plate and it is positioned to operate both the cock and the one-plate steel and pan cover – the frizzen. The straight upper leaf of the mainspring passes under the base of the cock and presses its heel upward. As the spring is very powerful, a ring is fitted to the screw tightening the jaws to offer extra purchase while cocking. The frizzen is distinctive being squat and squarish with the steel often grooved vertically. The sear, horizontally operating and traversing the lock-plate, has two arms which project through holes in the lock-plate in front of the cock and operates laterally by the pressure exerted by the sear spring. One arm engages the cock in the half-cock safely position and the other arm engages it at full-cock. The base of the cock has a pronounced toe with an angular chisel-like spur on the front. The half-cock arm terminates in large round and smooth sear (secondary sear) which projects through the lock-plate and engages under the angular bend of the toe as soon as the cock reaches the half-cock position. The full-cock arm ends in a flat lug (primary sear) which also protrudes through the lock-plate and engages the blade-like spur of the

toe from below the chiseled tip, when the cock is pulled fully back to the full-cock position.

When the cock is pulled backward, and before it reaches the full-cock position, the secondary sear on the half-cock arm uncovered by the chisel-like spur of the toe of the cock and the secondary sear are pushed out through a hole in the lock-plate by the sear spring to engage the angular bend on the toe and to hold the cock. When the cock is held in this half-cock safety position, it cannot be released by pressing the trigger, but the cock could be further pulled. When the cock is pulled fully – the full-cock position – the toe is disengaged and the flat lugs (primary sear) on the full-cock arm protrude through a hole in the lock-plate, by the pressure exerted by the same sear spring, and engage under the blade-like extension of the toe. Pressing the trigger with the cock held in this position withdrew both sears and the mainspring under tension drove the cock forward to strike the steel.

One of the characteristic features of the miquelet-lock is the frizzen – the combined steel and pan cover – or battery. The cock has a very short stem and is generally fitted with a square-cut or square-shaped jaw, and the flint has only short strikes are. The mainspring of the miquelet-lock is rather strong, and many miquelet-lock firearms are fitted with a ring or a small-shaped metal bar (spur) to provide extra purchase to the shooter's grip-hand.

Later features which exist in the examples and become associated with the miquelet in general are characteristic only to the majority of this lock (H.L.P. 219). These are the large external V-shaped mainspring, the externally mounted cock with no internal tumbler, the bridle supporting the lock screw, the upper cock jaw with its pin which passed through a hole in the lower jaw and the ring-headed thumbscrew for tightening the jaws on the flint.

The fact that all these features are common in one version of the earliest Scandinavian snaplock suggests the possibility of its introduction into the peninsula by Spanish Flanders. Then, it could have passed to the Spanish possessions of Sardinia and the Kingdom of the two Siscilies. An alternative theory holds that the lock originated in Italy. In any event, its progress must remain conjecture, for no country can establish its presence any earlier than Spain, where it was called, perhaps with considerable truth, the Spanish-lock.

The earliest examples exist (which can now be dated with certainly only between 1621 and 1641), although they probably more nearly approach the earlier dates of Madrid manufacture, and besides the above feature includes a lock-plate contoured to provide a minimum surface to mount the various parts; a striated striking face dovetailed to the body of the battery, a full-cock sear only, which retains the toe of the cock while the mainspring passes beneath and acts against the heel, a V-shaped battery-springs similar to that of the conventional flintlock, mounted forward of the mainspring and fieles on both battery screws. Fieles, small pins which passed through holes drilled in the threaded ends of these screws and corresponding holes in the lock-plate, served to secure the screws against loosening due to the movement of the parts they retained. They disappeared shortly after mid-century, and the subsequent lock screws were sometimes secured by striking their ends with a punch in order to spread the threads. Improvement threading seems to have obviated the need for these measures in the latter half of the seventeenth century.

An early method of scoring the battery face disappeared about the same time as the fiel. In this method, the striations appeared as ridges raised above the face rather than as a series of grooves. This is found only in combination with separate battery face which continued, until the nineteenth century. Otherwise striations were cut directly into the battery or, as in Madrid, often were not used.

A half-cock sear was introduced before 1644 in the form of a short round finger, notched to receive the toe of the cock. With the lock at half-cock, the toe in this notch prevented the sear from being withdrawn and accidentally igniting the piece. When the trigger was pulled with the lock at full-cock, this and the flat cock sear retracted simultaneously, allowing the cock to fall.

Apparently by ca. 1636, the forward mounted battery-spring was reversed, reduced in size and mounted directly under the pan where it was concealed by the battery screw bridle.

Contemporary with the above lock existed a variation called *agujeta*. In its original form, it differed from the earlier miquelet in the arrangement of its internal mechanism. Its full-cock sear engaged the heel of the cock while the half-cock sear operated in the normal manner against the toe which was forced downward by the lower arm of the mainspring. Fitted with a dog catch, this model was long manufactured in Ceylon, undoubtedly introduced by the Portuguese before 1658. While seventeenth-century Spanish examples are almost unknown, this lock, without the dog catch, was produced well into the eighteenth century both in Spain and southern Italy. It became known in Spain during period as *a la romana*. Almost identical with the conventional Spanish-lock was the *calze atras* or rear sear lock, differing from the former only in having its full-cock sear contact the cock heel while the arrangement of the mainspring remained the same.

In Brescia, the influence of the earliest Spanish-lock is evident in the continued use of the forward battery-spring until the last quarter of the seventeenth century.

A distinct rear sear miquelet-lock with a dog catch flourished briefly in Ripoli during the third decade of the seventeenth century. The lock-plate had the same deep drop as the Ripoli wheel lock. Earlier models had a projection on the outside of the battery to facilitate opening the pan while on all models the battery was actuated by a leaf spring. The fiel was not used.

However, from the earliest period of the ordinary miquelet, it was characterized in most cases by its fluted cock and battery bridles.

With the succession of the Bourbons to the Habsburg throne in 1700, the influence of the French gunsmithery invaded the Spanish court where it resulted in the creation of a bastard version of the miquelet-lock made in imitation of the French flintlock. Outwardly identical to the French flintlock, the cock was attached to a tumbler, useless because of the two sears and traversed the lock-plate to engage the breast and heel of the cock. Popular only in Madrid, where it was termed, *a la moda*, it endured for more than a century, and about 1825, the system was finally abandoned. It left traces in north Africa and the near East, where both versions of the Ripoli miquelet-lock had been introduced early in the seventeenth century and remained in vogue for almost 300 years.

Early in the eighteenth century, the French king Philip V acceded the Spanish throne. With the influx of the French nobility into the Spanish court, certain French styles influenced some Spanish arts to a considerable extent. This influence did not extend beyond the traditionalists in Madrid and they continued to order guns made in the Spanish manner. Decoration was standardized.

In Madrid, except for the change of ignition, the gun of the wheel lock period remained the same. However, barrels were lengthened to as much as six palms, and then shortly after became standardized approximately one yard. Pin fastenings were replaced by barrel bands. Gold-lined touchholes were known by 1644 and sights when used were of iron. A fluted gunstock was introduced before 1650 and quickly superseded the plain stock, but the earlier heel plate was retained; locks and mounts were finished bright and on finer pieces were often decorated with designs chiseled over a stippled ground. Barrels were blued, inlaid with gold at the breech and fitted with gold spider sights at the muzzle. The rear sight was often incorporated into the rear barrel band. Madrid gunsmiths prided themselves on the inability

to produce and often decorate an entire gun. Their names or marks are usually found on barrel, lock-plate and trigger guard.

In Ripoli, the earliest snaplock must have appeared in the first quarter of the seventeenth century. A miquelet variation with a dog catch and a deep drop to the lock-plate similar to that of the wheel lock is found only on the *pedrenyal* but does not appear to have been attempted to convert this gun to flint. Although similar in construction to the wheel lock and undoubtedly built around older barrels, the miquelet *pedrenyal* was distinct in always having a spherical butt. The style lasted hardly more than a decade.

Shoulder arms followed the earliest Madrid pattern, until in the first half of the eighteenth century the toe of the butt began to be elongated, giving a boot-like appearance to the butt stock, a style that became popular throughout the provinces. However, the fluted stock was manufactured to a small extent.

Unlike the gunsmiths of Madrid, those of Ripoli were divided into locksmith, barrelsmiths and stockmakers; the two former usually marked their products on the battery and breech.

Spanish gun-making techniques also came under the French influence and a group of sophisticated Spanish locks – generally classified as Madrid – locks were made from about 1700 to 1800, mainly in Madrid. Although this lock resembled a flintlock externally and bore certain characteristics of the contemporary French flintlock as it was basically a form of Spanish miquelet-lock. This typical instance where a politically dominating nation influenced the gun-making styles of the dominated nation resulting in intermingling of the civiles of both nations.

In the Madrid-lock, the mainspring is fitted and pressure is exerted on the tumbler mounted on the sock-spindle. It differed from the flintlock in having a more or less sear action as that of the miquelet-lock. The sear projected through the lock-plate to provide the full-cock engagement and the dog catch engaged the rear of the cock to provide half-cock safety

position. The Madrid-lock is found on some surviving examples of fine-quality fowling pieces as well as some military muskets.

Spaniards considered their miquelet-lock much superior to the contemporaneous flintlock, and patronized it for nearly 300 years, until adoption of the percussion system of ignition by about 1820. However, it is of interest to note that Roman locks were also made in Spain and miquelet-locks made in Italy. It is also not usual to find to find the Roman-lock fitted in Spanish stocks and Spanish miquelet decorated in the Italian manner. Miquelet-locks in general and Spanish miquelet-lock in particular had a glorious innings and were in use from the seventeenth century to the beginning of the nineteenth century.

The miquelet mechanism was equipped with two horizontal sears – which projected through the lock-plate and engaged, respectively, with the lug on the breast of the cock (half-cock) and another on its tail (full-cock). The lock which is first recorded in c. 1700 was confined almost exclusively to Spain and those parts of Italy under the Spanish influence. A rather similar mechanism developed independently from the snaphance, is, however, found on late seventeenth and eighteenth-century Scottish firearms.

A version of the Spanish miquelet-lock, generally known as the Morlacca type, was made for export to southeast Europe, the North coast and northern parts of Africa.

Perhaps, it would be more appropriate to group both the Spanish and Italian miquelet-locks under one classification – Mediterranean-locks – as they were used by most countries bordering the Mediterranean Sea, such as Portugal, Corsica, Sardinia, Albania, Greece, Turkey, Persia and finally Caucasus.

11.39 Miquelet-Locks of the Middle East

Turkish Miquelet-Locks (Fig. 11.31(a) to Fig. 11.31(k))

Persian Miquelet-Locks (Fig. 11.32(a) to Fig. 11.32(f))

11.40 The Arab Toe-Locks (Fig. 11.40(a))

The miquelet-lock, probably the Italian toe-lock type, was modified in the middle eastern region to the Arab-Toe-lock. The lock-plate is very large and long fitted with an external mainspring bearing down on the toe of the cock. In the later versions of the Arab-lock, the stud of the sear in the double-levered type protruded out of the lock-plate to give the full-cock position. The dog catch held the tail of the cock for half-cock. The dog is usually fitted with a small spring to keep it clear of the cock when unhooked. The mainspring acts on the sear and also moves a catch forward to hold the sear in position. This type of miquelet-lock was made in these countries from the early seventeenth century.

Moroccan firearms are fitted with another typical version of the miquelet-lock, perhaps made for export to north African countries. The jaws are shaped like two segments of a disc with their sides gripping the flint, and they are operated by a nut-headed screw. Here trigger guards are normally fitted.

11.41 The English Snaphance-Lock

As early as c. 1580, muskets fitted with snaphance-locks were issued to the British mounted regiments stationed in Ireland (Fig. 11.34(a) to Fig. 11.34(e)). Troops escorting ammunition wagon were also issued with snaphance muskets, as a precautionary measure against fire hazards involved when matchlock muskets with smoldering slow matches attached to them, were carried by the guards along with the ammunition they escorted.

Probably the Dutch or Flemish type of snaphance was the first to reach England. An English gunmaker modified it by fitting a dog catch, and in this form, it was in use, particularly on military firearms, from about 1600 to 1640. A one-piece laterally acting sear working through the lock-plate on the tail of the cock for full-cock (bent) provided the full-cock engagement and the extension on the rear bar which bore against a wedge on the tumbler gave the half-cock safety position.

In a later version of the English-lock, a tumbler was mounted on the cock spindle which had a notch or cut in it, the half-cock bent. When the cock is pulled to half-cock, a prong acting horizontally and working through the plate on the notch cut into back of the cock blocked the movement of the tumbler by engaging the bent. Pressure on the trigger did not dislodge the sear from the bent. In this type of English-lock, the dog catch, when fitted, served as an additional half-cock safety. A horizontal sear provided the full-cock by about c. 1640, the tumbler was modified further with a sear with two prongs acting horizontally on the tumbler. One prong engaged the bent for half-cock and the other engaged the tumbler for full-cock. The sear no longer protruded out of the lock-plate.

Obviously, English gunmakers of the period devoted much attention to produce a reliable safety system and the one-piece pan cover and steel was also adopted by them in the first quarter of the seventeenth century. With the introduction of the tumbler and the prong sear for the half-cock safety position, and quite frequently an additional safety – the dog catch – a shooter was able to carry a snaphance firearms fully loaded and primed, but with the cock in the half-cock safe position.

Early in the seventeenth century, a new category of military firearm – the dragon – came into general use in England. This was a snaphance, or wheel lock, carbine with the diameter equal to that of the musket. It was mainly used by the dragons, who until the middle of the eighteenth century were the mounted infantry. The dragon went out of use by about 1682 when the English dragoons were armed with a lighter snaphance musket – the fuses (an Anglicized version of the French fusil). The fusil soon came to mean exclusively a light musket which was more convenient to handle than the contemporaneous matchlock musket. It was of a type used in the eighteenth century by infantry officers and by light infantry companies generally known as Fusilliers. Peterson[234] records that the word fuses came to mean a light musket, and an England reference to *fuzees or long carbines* in 1680 seems to be an accurate contemporary description of certain weapons issued

to fusiliers, grenadiers, sappers, sergeants and other selected troops until the mid-nineteenth century. In 1773, the young Prince of Wales and his brother Frederick received small fuzees made in proportion to musquetes, which suggests that size and caliber were then the important point difference between the muskets and the smaller and heavier, fusil or fusee.

11.42 The Scottish Snaphance-Lock

Most probably the Anglo-Dutch, or the Anglo Flemish, version of the snaphance-lock was adopted in Scotland in the last quarter of the sixteenth century (Fig. 11.35(a) to Fig. 11.35(j)). This is one of the few countries where the true snaphance was continued to be used upto the beginning of the nineteenth century, while the flintlock had displayed it elsewhere in Europe.

The Scottish snaphance-lock has an internal mainspring, sliding pan cover and a separate steel. In the full-cock position, the cock was held by a stud on the sear protruding out of the lock-plate. A circular pan guard or fence is fitted at right angles to the outer edge of the pan. The lock-plate is long, narrow and graceful, with finials at both ends. The most conspicuous feature of the Scottish snaphance long guns of the seventeenth century, which are indeed rare, is the special style of the design and decoration.

Surviving examples of Scottish snaphance long guns could be broadly classified into two distinct types. First, these were fitted with rectangular trigger guards that terminated as a disc or scroll; a flat-combed cock streamed out at the rear like a horsetail and the flint was held between concave surfaced jaws held together by a nut-headed screw. The other types, bearing dates up to the end of the seventeenth century, are not fitted with trigger guards. Their barrels are rounded and are decorated only on the exposed surfaces, the sides being flat and plain. The former types of Scottish long guns are indeed very rare.

Snaphance-locks were also made with a horizontally acting sear operating through the lock-plate and terminating in a small stop, the projection in the front edge of the cock when the latter is drawn back. The steel and pan cover

are made in one. This type is stocked with the heart butt and appears to be made only in Scotland and is found on the majority of highland pistols of the eighteenth century.

11.43 The French Snaphance-Lock

There is no evidence to show that the snaphance-lock was made in France before c. 1600 (Fig. 11.36(a) to Fig. 11.36(c)). The few surviving examples indicate that both the Anglo-Dutch and Italian types of snaphances were made in France. However, it seems that the French were predominantly admirers of the flintlock and so the snaphance was soon discarded and substituted by the flintlock.

The last improvement to the snaphance-lock was the elimination of the clumsy release system of the cock. The new system was introduced by the beginning of the seventeenth century, c. 1600–1610; in this version, the tumbler is shaped like a round disc and is mounted on the cock spindle. On one side of the tumbler, a notch is cut to accommodate one end of the mainspring leaf. On the other side of the tumbler, two parallel notches are cut into which a sharp edge and a vertically operating sear impinge. With the introduction of these modifications, the true flintlock was well under way.

11.44 Later Snaphance-Locks

Early snaphance-locks were fitted with manually operated pan covers and the system was far from satisfactory. As the pan opened, the piece was cocked and the priming was exposed to the atmosphere for prolonged periods. In inclement weather, the pan could not be uncovered at all. Quite frequently, the shooter forgot to open the pan before pressing the trigger, resulting in a misfire. Therefore, a mechanism that opened the pan cover automatically was devised by gunmakers.

Many early systems that opened the pan cover automatically used the fall of the cock to activate a system of levers that pushed open the cover aside and returned it to the closed position when the piece was recocked. As

mentioned earlier, some German snaphance wheel locks were fitted with such a system by the third quarter of the sixteenth century. In the case of the Italian snaphances, the automatic opening of the pan covers was introduced by about the end of the sixteenth century.

Such safety systems naturally introduced additional levers, springs and so on, which complicated the lock mechanism. In the last quarter of the sixteenth century, a very simple safety system was introduced for the first time in Italy, in which the pan cover and the steel were combined as a single unit – the frizzen. It was invariably L-shaped, the shorter arm serving as the pan cover and the longer one as the steel. The frizzen was pivoted to the lock-plate at the end of the shorter arm so that when it was lowered to the firing position the pan was covered by the shorter arm and the steel stood vertically in front of the cock. The steel was so fashioned that when the cock fell, the flint it held first struck thetop of the steel and as it slided down its face the steel was pushed touncover the pan. Thus, when sparks were struck between the flint and steel, the pan was uncovered. The single unit called the frizzen, reduced the chances of misfire and the linkages introduced in the earlier systems were eliminated.

This system undoubtedly made the whole mechanism very simple, but it introduced a new problem, that is, when the pan was shut, the steel automatically was in the firing position and rendered the piece unsafe to carry once it was loaded and primed. Thus, a safety system was installed to ensure that the cock did not fall accidentally by inadvertent pressure applied to the trigger, and discharged the piece.

The earliest safety device was an additional manually operated pan cover, of the matchlock period, but this did not help much. It a later system, the steel could be moved out of reach of the cock after loading, priming and lowering the frizzen. The frizzen was made in two sections and put together as an L-shaped unit by means of a screw. By loosening the screw, the steel could be turned away from the cock (flint), so that the accidental fall of the

cock did not strike sparks. Surviving examples of snaphance show that this system of swiveling-steel was adopted in some Baltic-locks only.

By far, the most popular and widely adopted safety system incorporated an intermediate position for the cock – the half-cock – between the down- and full-cock positions. When the cock is held at half-cock, it was prevented from falling when the trigger was pulled.

Yet another method was to fit a catch, the dog catch to the lock-plate, just behind the cock. When the cock is pulled back to half-cock, that is, before the cock is locked at full-cock, the dog was hooked on to the tail of the cock to hold it in place until manually released. Pressure on the trigger did not release the dog as it was merely pivoted to the lock-plate and could only be operated manually. All snaphance-locks in which such dog catches are fitted are generally classified as dog-locks.

11.45 Dog-Locks

The dig catch has incorporated in various types of snaphance-locks for well over 200 years, and about eight different versions have been made (Fig. 11.37(a)to Fig. 11.37(h)). After the introduction of the half-cock notch, the dog catch was provided as an additional safety device. To improve the safety of the firearm, the cock was held by a catch and when the catch was released the cock would fall. However, the locks had a dog catch as an additional safety device or as the only safety device.

The snaphance had an effective safety device and that is the frizzen which could be moved out of reach of the cock while still remaining primed and ready to fire. However, if the cock slipped out of full-bent position, the gun was put out of operation until reprimed. For this reason, a dog catch was sometimes found on firearms with snaphance ignition.

Early in the seventeenth century, a development now known as the English-lock began to add safety features to the tumbler. It had a one-piece laterally acting sear working through the lock-plate on the tail of the cock

for full-bent and an extension on the sear bar which bore against a ramp or wedge on the tumbler (118).

A variant of the English-lock was with a half-cock notch on the tumbler but retaining the laterally acting sear working through the lock-plate on the tail of the cock. Another lock that fits into this category has a sear working through the lock-plate and catching in a notch cut into the back of the cock. The other type of dog-lock, the last of the flint arms to use the laterally acting one-piece sear, had a half-cock and full-cock position on the tumbler. The half-cock was held by a heavy hook on the sear bar which slipped over a lug on the tumbler. As the cock was drawn back to full-bent position, the sear nose moved into position at the top of a ramp cut into the tumbler. Judging from the existing examples of this lock, it must have become extremely popular from c. 1640, when it was introduced, until its demise about 1660 (S.L.G.).

11.46 Snaphance Long Guns Arms

Turkish and Persian miquelet long guns were generally fitted with heavy, sometimes massive, stocks of pentagonal section and a sharp step behind the barrel-tang. A characteristic feature of their gong guns and rifles is the dummy ramrod. The real ramrod was carried separately along with the powder flask. The barrels ranged from long smooth bores to short and heavy rifles of the dimensions of wall guns, locally known as *sher bacha*. A typical example of such a rifle in the museum is dated A.H. This rifle has a large oval rear sight with several apertures.

Firearms fitted with Arab toe-locks invariably have long barrels and straight stocks, but they are normally not fitted with trigger guards.

In Sri Lanka, an unusual form of the Arab toe-lock was made. It was fitted with a dog catch on the left side of the gunstock. The unique scroll-shaped butt, of the matchlock period, was invariably well decorated and ornamented.

11.47 Stock of Snaphance-Lock Firearms

Gunmakers realized that increasing the weight of the guns made it possible to use greater charges and calibers. Additionally, the stock was shaped in such a way that the gun did not kick and it was subjected to considerable force of recoil. The outstanding feature of the musket stock was its antirecoil quality. It was intended to give rear support and a high thin comb was fitted for this purpose. The foot of the butt was cut almost vertically and was therefore comfortable to place on the chest. To hold the gun, it was necessary that the thumb reached up and around the high butt. So there was a deep thumb groove cut in the comb of the butt.

The advantage of this butt was obvious. For guns of the same weight, it was possible to use bigger charges, or bigger calibers, or both. The greater range and penetration of the musket gave it military superiority.

The Spaniards used the musket stock during the first few years of their wars against the Netherlands. Thus, there is reason to believe that the shape of the butt was developed during the decades 1570–1580, and it is very likely that the Duke of Alba was the first to understand the great military value of the musket stock.

In the earliest forms, the musket butt was rather sharply curved downward and was short and fairly clumsy. This meant that the rear point of the support against the chest lay rather low compared with the axis of the barrel. The trouble with this, however, was that the gun muzzle raised considerably when the short went off; this caused much disturbance in the old days, when the powder burnt slowly. But already before 1600, the musket butt had developed its classic form; high, thin and with a slight fall. This form was preserved as long as the matchlock musket was used.

This soon influenced the sporting gun, which until then had been equipped with a German stock. When using a stock supporting the rear part, the gun could be made lighter without losing its effectiveness. In this,

flying shots were also possible. Finally, the chest shoulder support was an advantage when aiming.

It could be recalled that during the Netherlands campaigns, the Spaniards used the deadly musket, stocked with a typical shoulder butt. This type of stock was adopted by other European nations by c. 1580s. By the end of the century, it was developed further, most probably in the Netherlands, into the shape of a truncated triangle with incurved and a marked comb, behind a deep thumb-notch. It was set at a very slight angle to the line of the barrel. This spread rapidly to other European nations in the first decade of the seventeenth century and variations of it began to supplant all other types.

Early Swedish snaplock guns were stocked with a German oblong butt, but by the end of the sixteenth century a modified form of the triangular musket butt was introduced. Norwegian stocks of the late seventeenth century were fashioned with gently curved slightly slopping butts.

Lock-plates on long arms were generally made smaller as the century progressed (17th) but most change was in the shape of the stock. The old high comb on the butt with its deep recess cut for the thumb was gradually replaced by the simpler triangular butt. In order to give support to the screw which pierced the stock to hold the lock in place, a metal strip or plate, the side plate, was also introduced. A small plate, often a shield shape, was fitted near the breech end of the butt on which could be engraved the owner's badge, initials or arms.

A more or less similar development seems to have taken place in France also, which was complete by about 1650. These two trends of development of the triangular musket butt ultimately resulted in an early stock found so often on flintlock guns, generally known as the straight European stock.

By the last quarter of the seventeenth century, north Italian guns and rifles were fitted with a type of butt having a straight lower edge, from the trigger guard to toe a circular grip and a rounded heel. This perhaps was one of the

early versions of the so-called bellied butt and it appears that it was adopted from the French butt.

Gunstocks of Spanish miquelet firearms could be classified into two distinct categories, the Catalon and Madrid stocks. The butt of the Madrid stock was set at a downward angle to the barrel; fashioned with a rounded wrist extending far into the body of the stock; had straight upper and lower edges and carved with parallel flutes on both sides of the body of the stock. The Catalon stock was boot-shaped and fitted with a butt with a gracefully swept down and incurved edge terminating in a wide toe and a prominently straight comb, from the thumb-notch to the heel of the butt.

Due to scarcity of good walnut in Spain, gunstocks were mainly made of local fruit woods, normally cherry. Although these woods could retain an excellent finish, they were not so strong, or as dense, as walnut, and so barrels were normally attached to stock with metal bands. The miquelet mechanism needed only a shallow cavity in the stock to house it, mainly because of the external mainspring. Due to poor densities of fruit woods they were not very useful for stocking flintlocks, as the stock would be rendered weak at the place where the lock was housed. However, due to the exterior mainspring, the miquelet-lock could be housed in a shallow cavity in the stock without unduly causing a weak spot in the stock. Ultimately, they gave way to the common European gunstock. Keys replaced the traditional barrel bands and the European style began to dilute the Spanish flavor. Isidrosoler died in the year 1825. He was the best great Spanish gunsmith and also the head of Spanish gunsmithery.

Barrels were usually pin-fastened to full stocks of cherry, walnut or pear. The slight downward curve of the butt was broken by an indented thumb rest. Instead of the butt plate, a small L-shaped steel plate protected the heel. The trigger guard was rectangular with a small spur.

Scottish snaphance long arms of the seventeenth century were stocked with uniquely fashioned and decorated stocks. They were mainly of two

types. The earlier of the two sloped down in a gentle graceful curve and was fitted with a rectangular trigger guard terminating in a scroll or disc. The other type, introduced later, was fashioned with a deep and graceful curvature, with the upper and lower edges slightly diverging toward a wider butt plate. The butt was curved on both sides with three parallel flutes, which is a characteristic feature of this type of stock. No trigger guards were fitted, presumably because the deep curvature of the butt was considered adequate to protect the small button trigger normally provided.

The so-called belied butt, another distinct type of gunstock, developed from the sixteenth-century musket was first introduced in France in the second quarter of the seventeenth century. It had a straight or slightly saddle-shaped upper edge and a deeply convex lower edge. It first appeared in c. 1630 and was in use until c. 1660. But its modified form was in use till the end of the century. French snaphance military muskets were also fitted with the plain believed butts, with or without cheek rests and steel mounts. This type of butt was revived later and gradually assumed a distinct style – the pistol butt and became the second most popular type of butt in the flintlock era.

11.48 Stocks of Snaphance-Lock Longarms

To summarize, snaphance-lock longarms were initially fitted to the type of stock in vogue for matchlock and wheel lock firearms, with slight modifications to the new lock. When mainspring of the snaphance was mounted internally, it was also possible to house the entire lock mechanism, excepting the cock, steel and pan, within the stock. The overall dimensions of the new lock could be now reduced and consequently it was also possible to streamline the external shape of the grip into a narrow and tubular shape. This new trend of stock design ultimately resulted in the development of the most popular form of gunstock – the straight European stock.

11.49 Stock of Snaphance-Lock Pistols

Many of the early snaphance actions were fitted into stocks that were originally designed for wheel locks (Fig. 11.41(a) to Fig. 11.41(b)). A number of surviving examples have the characteristic lock-plate shape of the wheel lock with the large semicircular extension at the center. Many plates were left plain but some gunmakers, like the Russians for instance, accepted the opportunities offered by the large area to carry out some extremely fine decorative chiseling thereon. Soon the stocking styles became the forerunners of those fitted later to flintlock pistols. The only one of Scottish origin.

While gunmakers of Edinburgh and Glasgow (lowlands) made conservative English snaphance pistols, those made in the highlands made the distinctive highland pistols. They were stocked in several distinct styles from about 1610 to about the early nineteenth century.

Some Scottish snaphance pistols had wooden stocks, but the majority of surviving examples have metal ones. Those of the early period are usually brass, occasionally glit, but those that followed, after c. 1650s, are invariably of steel. Their locks, stocks and barrels are often partly, or entirely, engraved with the Celtic strap work and filigree and are sometimes inlaid with plaques and bands of silver. Almost all are fitted with long flat belt hooks on stocks on the opposite side of the lock-plate. A pricker for clearing the vent is usually screwed into the center of the butt cap. Triggers of early pistols are invariably shaped as turned finials, while those dating from after c. 1650s take the form of a small spherical button. Trigger guards, however, are not fitted at all. Most pistols dating before the end of the seventeenth century have right-or left-handed locks.

Scottish pistol butts are classified according to the shape of the butt end. Those frequently found on surviving examples are the fishtail, lemon, heart, ram's horn and lobe types.

The fishtail butt is flat with straight sides diverging slightly toward the bottom and terminating in three lobes vaguely resembling the tail of a fish.

Most examples have wooden stocks and a few of brass.

The lemon butt is fitted with a pommel of globular or ovidal shape often polygonal in section. The butt is usually made of brass.

The heart butt is most probably a modified version of the lemon butt. As its name implies it has a heart-shaped pommel of oval section and is invariably made of steel.

The Ram's horn, or scroll, type of pistol butt appears to be developed from the fishtailed butt. The butt is entirely of steel and is the commonest type of butt used in the eighteenth century. Early in this century, the butt became curved and the whole pistol developed into a graceful shape. It survived as a part of the highland dress, particularly of officers of the Scottish Regiments, until the second quarter of the nineteenth century.

The lobe butt is very similar to scroll butt except that the butt is of a rounded section and is domed at the butt end. It was made in the second half of the eighteenth century.

Ripoli snaphance pistols of the sixteenth century were generally fitted with belt hooks and worn on xarpas or bandoliers, which were made with small loops.

Snaphance pistols were made in Scotland and in northern and central Italy after the introduction of the flintlock firing mechanism. The area around Brescia became famous for the superb steel-carved furniture and ornamentation of chiseled steel upto the eighteenth century.

The Spanish snaphance pistols, but for the change to the miquelet-lock, continued in the later wheel lock. Variations were made in the stock, one of which approximated to a miniature gun butt, but the spherical ball remained the most popular.

11.50 The Flintlock or Fire-Lock

In the seventeenth century, the matchlock, wheel lock, snaphance-lock and flintlock were all patronized by their respective admirers (Fig. 11.42(a) to

Fig. 11.42(j)). The military were perhaps the main patrons. For instance, in England, the matchlock musket was standardized for military use by the last quarter of the sixteenth century and remained as the main infantry longarm until the middle of the seventeenth century. However, new and better types of systems of ignitions were adopted by the British sportsmen for sport, in this period.

The snaphance-lock mechanism was simple but its main drawback was the problem of mechanically coupling an automatic opening of the pan cover and a really effective and dependable safety arrangement. Mainly to overcome this, and also to refine and simplify the snaphance mechanism, gunmakers sought new types of locks. Numerous intermediary or transitory systems of ignition retained the basic working principles of the true snaphance but incorporated several improvisations that were basically forerunners of the true flintlock.

It took nearly a hundred years before the true flintlock was invented after the introduction of the snaphance, and it was a great leap in the field of firearms development. It was actually a combination mechanism used in earlier locks to create a simple efficient mechanism. The credit for finally developing the true flintlock goes to the French, who successfully combined certain mechanical aspects of the French snaphance miquelet-lock and produced the flintlock –often referred to as the French flintlock, which became the standard for the next hundred years or so.

Although the term flintlock appears for the first time, that we know of, in 1683 (Turners Pallas Armata), it is generally accepted that the flintlock was introduced for the first time in France during c. 1610–1615, and the credit for inventing it goes to a Normandy gunmaker, Marin le Bourgeoys of Lisieux, the artist – mechanic of the French King Louis XIII. Snaphance was already equipped with a tumbler linking the mainspring and cock in the sixteenth century. There is one Italian example of the second half of the century, in the Artillery Museum, Turin. It has a combined steel and pan cover. It can be shown that these features, combined with a vertically

operating sear engaging the notices in the tumbler, were in use in France before 1615. The evidence for this is provided by a flintlock gun made for Louise XIII, now in the Renwick Collection at Tucson, Arizona, which bears a mark of Jean le Bourgeoys of Lisieux in Normandy who died in 1615. Earlier than the Renwick example is another flintlock gun from the collection of Louis XIII, in the Hermitage, Leningrad, which is signed by Jean's brother, Marin le Bourgeoys. If the tradition that this gun belonged to Henry IV is correct, it must date from before 1610. In any event, it is the earliest flintlock known and is therefore the inventor of the system.

Perhaps, the only other country to which the credit for inventing the flintlock could go is England. In the English-lock, the vertically operating sear acts on a notched tumbler mounted on the cock spindle, and, of course, the steel and pan cover are made as a single unit. The former was introduced well before the first decade of the seventeenth century, which is before the French flintlock is believed to be invented.

As far back as the second half of the sixteenth century some gunmakers had combined the pan cover and the steel from which sparks were struck into a single L-shaped piece of metal but the idea had not developed. By combining the two units, the action of the striking sparks could also uncover the pan at the same time for the force of the blow caused the arm to pivot. Marin took the combined pan cover and steel and used that for its simplicity of action since it required less moving parts. The other features Marin adopted were the use of a tumbler or metal block, situated on the inside of the lock-plate and connected to the cock on the outside.

As the cock was rotated so was the tumbler, and it was on this the mainspring pressed rather directly against the cock. In the snaphance, the cock had been engaged by a metal arm, the sear, which passed through the lock-plate. In the French lock, the sear was fitted inside the lock-plate and pressed directly on the broad edge of the tumbler. As the cock was pulled back from the tumbler, it was rotated and the sear slid along until it engaged with a slot into the tumbler when it locked and so held the cock under

tension. Pressure on the trigger disengaged the sear and allowed the mainspring via the tumbler to swing the cock forward to strike sparks from the steel.

A wedge-shaped piece of flint was gripped between the jaws of a mechanically propelled arm. When the trigger was pressed, the arm moved forward to swing the flint through an arc. The edge of the flint was so positioned that it rubbed down the surface of the flat steel plate-producing minute sparks of incandescent steel and the sparks dropped into the priming powder. This was to form the basis of ignition method of firearms, pistols and longarms, for the next 140 years.

11.51 True Flintlock

Initially, the term flintlock was indiscriminately applied to any type of gunlock that was ignited by a spring-loaded cock holding a piece of flint striking a steel (hammer of frizzen) pointed vertically facing the cock (Fig. 11.43(a) toFig. 11.43(i)). Later, the term was used to a gunlock in which the steel and pan cover were combined as one component. It was Dr. Torsten Lenk[235] in 1939, who first spelt out the accepted definition of the true flintlock as a snaphance that has the steel and pan cover combined and the sear operating vertically to engage the notches – giving, respectively, half-cock (safety) and full-cock – in a tumbler attached to the inner end of the cock spindle. Some writers, in deference to the nineteenth-century classification, call the lock as the *true* or *French* flintlock.

Nevertheless, in the flintlock the steel and pan cover are made as one composite unit, and a sharp-edged, vertically operating sear engages two parallel notches cut in the tumbler or metal block, situated on the inside of the lock-plate and attached to the inner end of the cock spindle, giving, respectively, full and half-cock (safety). As the one piece steel and pan cover was already incorporated in the Italian-lock and miquelet-lock of the second half of the sixteenth century (of which an example is in the Artillery Museum, Turin), linking the main spring and cock spindle was used in the

sixteenth century German and Anglo-Dutch snaphance-lock and the notched tumbler was already used in the England-lock; the only new idea was the inclusion of a double notched tumbler engaging a vertically operating sear, to give, respectively, half-and full-cock.

The typical French flintlock consisted of a metal plate lock-plate let into the side of the firearm. On the outside was a graceful S-shaped arm – the cock – which held the piece of flint between two adjustable jaws. The pan was also an integral part of the lock-plate. To prevent powder being lost in the wind or damped by rain, it was covered by a metal plate. The pan cover was attached to the steel face that produced the sparks. This L-shaped piece of metal – the frizzen – was held down over the pan by means of a small V-shaped spring – the frizzen spring – and the cock was pulled back as far as it would go and then locked into place by a small metal arm on the inside of the lock. When the trigger was pressed, the arm was disengaged and under the pressure of the large V-spring the arm swung forward. The flint scraped down the steel – making sparks and at the same time tilted the frizzen clear of the pan – allowing the sparks to drop into the priming and so firing the piece.

The steel acted against a V-shaped feather spring on the outside of the lock-plate as in the snaphance. On a few locks dating from before c. 1650, the steel-spindle is equipped with a tumbler that acts on a spring inside the lock-plate. About 1650, a new method of attaching the cock was introduced. The cock is secured to a square shanked end of the cock spindle that projected through the lock-plate into a corresponding hole in the cock, the two being held together on the outside by a central screw. Another feature that appeared at the same time was a small bracket or bridle screwed to the inside of the lock-plate to act as a bearing for the tumbler, which had hitherto been supported by the cock pivot only.

The cock is screwed to one end of the cock spindle, externally, and a specially shaped metal disc – the tumbler – is also rigidly mounted on the same spindle. The tumbler bears directly on a large V-spring – the

mainspring – and compresses it when the cock is pulled backward. Two notches of varying depths and angles are cut on the face of the tumbler. A small sharp-edged, vertically operating arm – the sear – bears against the tumbler. As the cock is pulled back, and before it reaches the full-cock, the sharp end of the sear slips into the first notch on the tumbler. This notch is so designed that pressure on the notch does not disengage the sear from the notch, which means that a pull on the trigger does not release the cock. This position of the cock, between the down and cocked position, is, therefore, known as half-cock safety. When the cock is pulled further back, the sear automatically disengages from the first notch and slips into the second notch. This notch is so designed that when the trigger is pulled, the sear withdraws from the notch and releases the cock. The pressure exerted by the mainspring acting on the tumbler then rotates the tumbler and swings the cock forward to strike the frizzen with the flint held in its jaws. The impact of the flint against the steel of the frizzen not only struck sparks but also pushed aside the flint and in so doing opened the pan in time to admit the sparks into the pan.

The early flintlock had a flat plate, often attached by two screws, instead of the three used for the contemporary snaphance. The cock, too, was flat and rectangular in section, often with a lateral piercing in which the lower end of the jaw screw moved (135); it was attached to the tumbler by a bolt with a nut on the outside. The internal mechanism was far simpler than that of the wheel lock and comparatively, more reliable. It was certainly cheaper to produce, simpler to maintain and repair. There was a safety position for the cocks that the firearms could be carried loaded and primed. Despite these inherent advantages, it was not immediately accepted and seems to have been used by the French gunsmiths for the first twenty or thirty years of its life. By the middle of the seventeenth century, however, it was more widely used and had soon displayed other systems. Armies were soon equipped with new flintlock muskets and the flintlock was widely adopted in Europe and it had virtually supplanted the snaphance in all the major European

countries excepting Spain and Italy. Elsewhere from the last quarter of the seventeenth century to the third decade of the nineteenth century, it was the only means of ignition for almost all types of hand firearms. Even after the invention of the percussion system of ignition, it gradually came into disuse in the west and in many other countries it has retained its popularity to the present century. In certain regions of Italy, the national form of miquelet remained popular. Perhaps Spain was the only country in Europe where the flintlock was never popular as it was considered much inferior to their miquelet-lock, and true Spanish flintlocks are almost unknown, excepting on some late military firearms. Also, in the far eastern regions, beyond India, surviving examples of indigenous flintlocks are extremely rare.

In the seventeenth century, certain modifications were introduced to improve the shape of the flintlock. Those dating from the middle of the century had flat lock-plates and flat-sided cocks and the lock-plate was fashioned with a distinct drooping shape. Toward the end of the century, banana-shaped lock-plates were fitted, whereas both the cock-and lock-plates were of lozenge-shape and half-round in section.

In the 1650s, the cock assumed the graceful "swan-necked" or "gooseneck" shape, which remained the most popular of the matchlock's history, although military arms were often still fitted with the pierced cock, known in the eighteenth century as a "throat-hole" cock. The 1650s also saw the beginning of a fashion, originating in Paris, for rounding the surfaces of the cock-and lock-plate. This survived until almost the end of the eighteenth century, though flat cocks and lock-plates, usually with beveled edges, which came into favor again in the 1690s, were more common after about 1750 (135).

11.52 Improvisation and Refinements of Flintlocks

Flintlock mechanism was improved further:

The Detent. This was a small pawl attached to the tumbler that prevented the sear from catching in the half-cock notch (or bent) as the cock fell. It is first recorded in French firearms of the late seventeenth century, but it did not come into wide use until the second half of the eighteenth century (135).

The Roller Bearing. From about 1770, a roller bearing was sometimes fitted to the steel spring or to the steel itself. This reduced friction so that the steel flew back more quickly and produced more sparks. The same period saw the introduction of a small swivel linking the mainspring to the tumbler, also to reduce friction. Both features became common after about 1785 (136).

Waterproof Pans. Many flintlocks from about 1780 onward were fitted with waterproof pans. These had a raised rim over which the pan cover fitted like the lid of a box, while the curved fence behind the pan – designed to protect the shooter's eye – was pierced with a small drain hole.

Additional Safety Device. Though a flintlock was theoretically safe when at half-cock, many examples are fitted with the dog catch which, though rare after c. 1700, survived until the middle of the eighteenth century. From c. 1720 onward, the commonest safety catch was a sliding bolt which locked the cock (136). On box-lock pistols, this was frequently combined with a device for securing the steel in the closed position (136), both often being operated by moving the trigger guard forward.

In 1812, Joseph Manton of London patented his gravitating stop, a device designed to prevent a gun from being fired accidentally while being loaded at the muzzle. It consisted of a small weighted lever made in one with a pawl and pivoted to the lock-plate (136). When the gun was held with the muzzle upward, the weight on the lever caused the pawl to engage in a notch in the cock, thereby locking it; when the gun was moved into any other position, the weight withdrew the pawl.

11.53 Some Important Developments of the Flintlock Era

Gunpowder, also known earlier as black powder, invented in the middle ages, remained unchanged for hundreds of years thereafter. Even in the mid-seventeenth century, its composition was far from the requirements as a propellant. It was slow-burning, produced dense clouds of smoke and large quantities of powder were needed for a single shot charge. The gun kicked like a mule and the barrel required frequent cleaning and washing to effectively remove the accumulations of residues of the burnt powder.

Due to the slow-burning qualities of gunpowder, appreciable time-lag occurred from the time the trigger was pulled to the time the projectile emerged out of the gun muzzle. Also, black clouds of smoke emerged from the pan and gun muzzle, and practically obliterated the target for a considerable period after firing a shot. By the middle of the seventeenth century, the quality of gunpowder was improved by adopting a new formula, for its composition, 75% saltpeter, 10% sulfur and 20% charcoal. The rate of burning of the mixture could also be controlled by converting the powder into grains of varying sizes – the larger the size of the grains, the slower the rate of its burning. The smallest size FFFg was for handguns, the medium size FFg was for shotguns and small bore rifles and Fg was for big bore rifles. The powder compounded for cannon consisted of very large granules.

At this stage of development of firearms, an important historical event changed the indifferent attitude of the English sportsmen toward the gun as an implement of sport which set a new English gun-making industry with far-reaching results. The English royalists exiled in France, along with Charles II, were highly impressed to see the French sportsmen bringing down flying birds with their light weight flintlock fowling pieces. This type of wing-shooting was undoubtedly made possible by using gunpowder of superior quality that enabled the continental gunmakers to reduce the length of gun barrels, and consequently the overall weight of guns. Introduction of the flintlock system of ignition also rendered the fowling pieces less susceptible to inclement weather and made them fit for outdoor shooting.

Probably, the exiled royalists learnt wing-shooting techniques in France and introduced this form of shooting to the English sportsmen in c. 1669 (Restoration). Fortunately, this new form of shooting became popular with the aristocracy and gentry of England and soon demands for good quality guns increased. This gave the English gunsmiths the much needed patronage of the wealthy sportsmen and they soon built up a lucrative trade in firearms manufacture.

However, in England, possession of continental fowling pieces continued to be status symbols in the seventeenth century. In 1672, a royal charter was proclaimed prohibiting sale of all guns, including the imported ones, unless they were *prooved* and stamped with proof marks by the Gunmakers' Company of London. This measure of quality control not only discouraged indigenous production of poor quality firearms but also put an end to the import of substandard firearms from the continent. As a result, demands for good quality firearms increased rapidly in England and some enterprising gunmakers and skilled gunsmiths started producing quality firearms by the end of the seventeenth century.

London and Birmingham gunmakers produced fine-quality flintlock firearms, though London gunmakers were definitely the better of the two and dominated the firearms industry for the greater part of the eighteenth century when Birmingham started becoming a serious competitor. In the initial stages, gun-making industries were established around the Tower of London, as the main customers were the British Government and their agencies. But later, some firma spread out farther away and established factories at Piccadilly, Oxford Street and the other newly extended localities of London.

The earliest surviving example of a double-barreled fowling piece, made in England by W. Palmer of London in 1680, having 42" barrels of thirty bore and weighed about 7 pounds 10 ounces. The barrels are placed one over the other (over and under) with a pan each. The barrels could be rotated so that

each was brought, in turn, to line up with the cock ready for firing with the single trigger.

In France, the Protestants (Huguenots) were subjected to religious persecution by the Catholics after the Revocation of the Edicts of Nantis in 1685. The brutalities to which they were subjected were so severe that they fled to England and other countries, among them was the greatest of all gunmakers to migrate to London, Pierre Moonlong, who was later appointed the gunmaker of Ordinary William III, the English king. A pair of English Royal Flintlock holster – pistol made in c. 1690–1700 by Moonlong – was sent for sale by Anne, Duchess of West minister, to be auctioned by Sotheby Parke-Bernet, London. They were purchased by a London dealer Howard Rickets, on December 17, 1974, for a sum of about Rs. 1,42,000.

Moonlang was followed by other famous personages, such as Jacques Goege, an artist – mechanic and the designer of some ingenious multishot firearms; Isaac de la Chaumette, the designer of the breech-loading system that was eventually to start some radically different trends in developing firearms.

Henry Nock, a London gunmaker, who was active from 1760 to 1810 and was famous for making both civilian and military firearms, designed a lock in which no screw was used to facilitate easy dismantling and reassembling of the lock with the use of minimum of tools and equipment. He also produced the seven-barreled flintlock for firing volleys. His best contribution was the invention of the so-called breech-plug, and a special breaching method (patent number 1598 of April, 1787). This method combined with the use of good quality gunpowder ensured that the charge in the chamber of the gun ignited all at once, instead of starting from the vent and spreading slowly to the rest of the charge. Quicker combustion of the powder charge resulted in the reduction of barrel lengths. The usual 92 cm (36″) shotgun barrel that often flared at the muzzle was reduced in length to about 75 cm (30 to 32 inches), with a uniform cylindrical bore. The shorter barrel and lighter working parts naturally reduced the overall weight

of the gun, which enabled the gunmakers to add an additional barrel to the gun without rendering the gun unduly heavy and unwieldy. The shooters could now get two quick shots with one loading.

Lead shot was originally made by the tedious process of cutting lead sheet of appropriate thickness, first into strips and then into small cubes.

A feature borrowed from the snaphance, which is found only on the earliest flintlocks, is the small stop, or buffer, screwed to the lock-plate in front of the cock, which was designed to prevent the cock from descending too far (131). After c. 1630, this was replaced by a step or shoulder, a cut in the inner face of the cock, which performed the same function as the buffer by catching on the top edge of the plate (131).

Before c. 1650, the base of the flat cock was drilled with a square hole and a bolt with a slotted head at the outer end and a squared shank ending in a threaded portion fitting snugly. The lock-plate was drilled with a larger hole through which the squared end of the bolt could rotate freely. The tumbler was also drilled with a square shank of the bolt that could fit snugly, and its threaded portion could be tightened into a nut. After c. 1630, however, a square nut was made with the tumbler and passed freely through the lock-plate and accommodated snugly in the square hole in the cock. A simple slotted bolt was screwed into the nut and held all the components together.

The earliest flintlock known is a French flintlock gun made and signed in full by Marin le Bourgeoys and dated by Lenk as probably not later than 1610. According to Peterson[236], the gun is believed to traditionally belong to Henri IV in which case it must date from before 1610. This flintlock gun is in the Hermitage, Leningrad and is a unique piece of art in its own right.

Another flintlock fowling piece made for King Louis XIII in c. 1615 made by Jean le Bougeoys, a brother of Marin, was auctioned recently for about Rs. 25,00,000, the highest price ever paid for a single gun. A London dealer F. Partridge purchased this piece from Sotheby & Co., London, on

November 21, 1972, and is now in the collection of the late William Goodwin Renwick at Tucson, Arizona, USA.

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Chapter 12
Annexure

To give completeness to the work, some items have been added to the original manuscript. These items are not part of the original manuscript but our mere interpolations so that the book is interesting to the readers and fellow arms historians. These are butt styles, lock styles and makers marks found on weapons. For these subjects, we have relied on Blackmore (*Guns and Rifles of the World*–1965, pages 106 to 115) and (*Blair European and AmericanArms*–1962, pages 116 to 122).

Butt styles could be broadly classified as cheek butts, shoulder and chest butts and pistol grip butts.

They could also be classified depending on their popularity in various regions such as Straight European Butts, Mediterranean Butts and Oriental Butts. The various types of butts also assist in identifying firearms to their area of production.

The maker's marks on weapons give a very important clue about two things; the place and period of manufacture is also a very important pointer toward the identification of a particular firearm.

Gun locks are very critical to the identification of firearms, but difficulties are met in identifying the early locks that are simple and uncomplicated compared to the later locks that are more developed and sophisticated. To overcome these difficulties, we have tried to incorporate as many illustrations as possible, from very detailed drawings to some simple line drawings in the hope that the reader would get a fair and accurate picture of various locks because that was our initial objective. We have retained the

numbering system as per Blackmore only for the purpose of continuity for serious readers/researchers in the subject and also as a starting point for future works on the subject.

This section of the book is mainly divided into four parts: Proof Marks (Fig. 12.1), Gun Butts (Fig. 12.2) and Lock Mechanisms (Fig. 12.3). Keeping in view the detailed discussions on these subjects in the main parts of the book, many illustrations have been provided so that the reader could easily correlate with what has been explained earlier.

While on the subject of illustrations, it is quite impossible to collect, collate and reproduce illustrations for all possible combinations in this vast subject. We do acknowledge that there are many gaps that need to be filled but we assure you that given the constraints of time, space and resources we feel that a satisfactory job has been done and due diligence and effort have gone into the draft of the manuscript. Still some discrepancies would have crept in and the authors while taking full responsibility for this would also consider it as a starting point for other researches on this subject.

It is felt that we have made a humble beginning in this field and we hope to have provoked or motivated arms historians for research and further studies on this fascinating subject.

Pradeep Kumar Phillips

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